May 1954

MECHANICAL ENGINEERING

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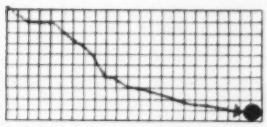
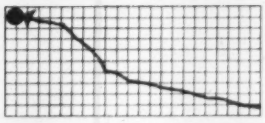
YOUR POWER COSTS ARE WAY DOWN HERE

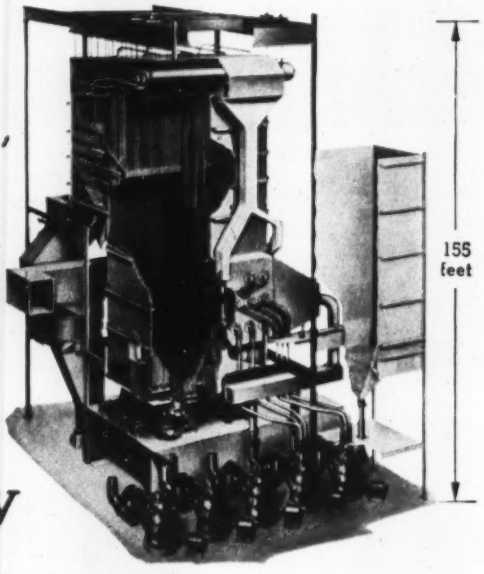


instead of way up here  because ever since **1881,** when Thomas A. Edison

installed this B&W boiler

in America's first central station on

in New York, B&W has committed men, machines and money to a fruitful, continuing search for better ways to make steam and get more energy from common fuels.



Today's power boiler stands this high. It stands for power progress and the pledge to keep research and engineering first --to produce even more steam power at lower cost.

BABCOCK & WILCOX
BOILER DIVISION
N-182

Its Tra[illegible]n Tells the Story!

14 BALL BEARINGS IN EIMCO'S NEW UNIDRIVE— ALL NEW DEPARTURES!

Fourteen New Departures in Eimco's Unidrive transmission keep shafts and gears always in accurate alignment . . . assure peak performance with virtually no maintenance.

Rough terrain and tight spots are no problems to Eimco's agile 105 Tractor-Loader with its new Unidrive transmission. And contributing to the Unidrive's advantages are 14 New Departure precision **ball** bearings. These New Departures mean positive, accurate positioning of the closely related moving parts. They carry radial, thrust and combination loads. They permit compact, rugged design . . . assure long life with no need for adjustment.

Whatever the bearing problem, New Departure can help you. When improving a product or designing a new one . . . *talk to your New Departure engineer.*

NOTHING ROLLS LIKE A BALL

NEW DEPARTURE
BALL BEARINGS

Plants also in Meriden, Connecticut and Sandusky, Ohio

NEW DEPARTURE SALES ENGINEERING OFFICES—AT YOUR SERVICE

BRISTOL	269 North Main St.	2-6371	**DETROIT**	7-122 General Motors Bldg.	Trinity 2-4700	**KANSAS CITY**	1021 E. Linwood Blvd.	Valentine 4939
BOSTON	517-A Park Square Bldg.	Hancock 6-9867	**CINCINNATI**	2107 Carew Tower	Main 5783	**MILWAUKEE**	647 W. Virginia St.	Broadway 6-9460
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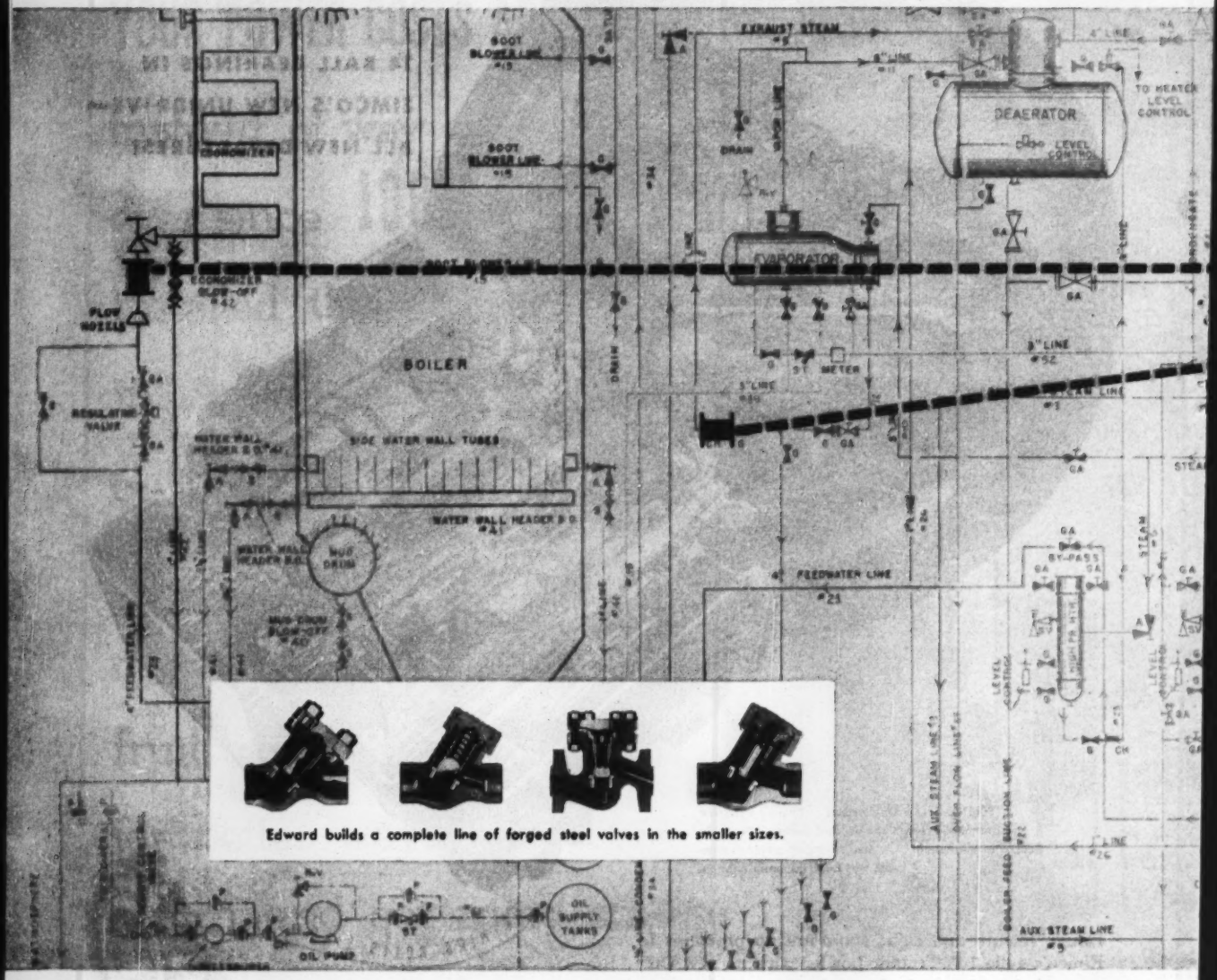
PHILADELPHIA	850 E. Luzerne St.	Garfield 3-4136	**PITTSBURGH**	Cathedral Mansions	Mayflower 1-8100	**BERKELEY**	1716 Fourth St.	Landscape 6-8750
SYRACUSE	2360 James St.	73-5195	**CHICAGO**	332 So. Mich. Ave.	Wabash 2-5875	**SEATTLE**	5000 First Ave., S.	Lander 5920
			DAVENPORT	2212 E. 12th St.	Davenport 7-7522			

MECHANICAL ENGINEERING, May, 1954, Vol. 76, No. 5. Published monthly by The American Society of Mechanical Engineers, at 20th and Northampton Sts., Easton, Pa. Editorial and Advertising departments, 29 West 39th St., New York 18, N. Y. Price to members and affiliates one year $3.50, single copy 50¢; to nonmembers one year $7.00, single copy 75¢. Postage to Canada, 75¢ additional, to foreign countries $1.50 additional. Entered as second-class matter December 21, 1920, at the Post Office at Easton, Pa., under the Act of March 3, 1879. Member of the Audit Bureau of Circulations.

What you should know about



Edward builds a complete line of forged steel valves in the smaller sizes.

In the 50 years since Edward designed and first built steel valves, experience and research have revealed many facts about check valves. Here are some of the most important.

SELECTION POINTERS . . . that will improve your check valve efficiency.

1 The proper size valve is the most economical. Too small a valve has a high pressure drop and wastes power. Too large a valve requires unnecessary effort to operate and disks may hug the valve seat at low flow causing vibration and excess wear. (Edward Bulletin No. 12H describes a simple method for computing correct check valve size.)

2 In selecting check valves, the piston type has at least five big advantages over the swing type:

(a) dashpot action of piston type check valves prevents slamming—eliminates damaging shock;

(b) disks give a tighter seal;

(c) more complete guiding minimizes vibration of moving parts;

(d) angle designs to replace elbows are possible in piston type check valves;

(e) disks can be easily re-lapped when necessary.

3 In higher pressure steam generating plants, Pressure-Seal bonnet designs are rapidly replacing the cumbersome, heavily-bolted bonnets. Here are several especially desirable features:

(a) pressure-seal bonnets stay tight regardless of temperature-pressure variations;

(b) fewer bolts, lighter covers and bonnets reduce maintenance costs;

(c) pressure-seal offers a higher degree of part interchangeability;

(d) lower pressure drop in streamlined pressure-seal designs permit use of smaller piping and valves . . . saving space, weight and costs.

(e) and pressure-seal construction improves streamlining which reduces wear-inducing turbulence;

(Edward has built PRESSURE-SEAL valves for ten years and its continuing research has developed many new features that reduce maintenance and improve sealing qualities.)

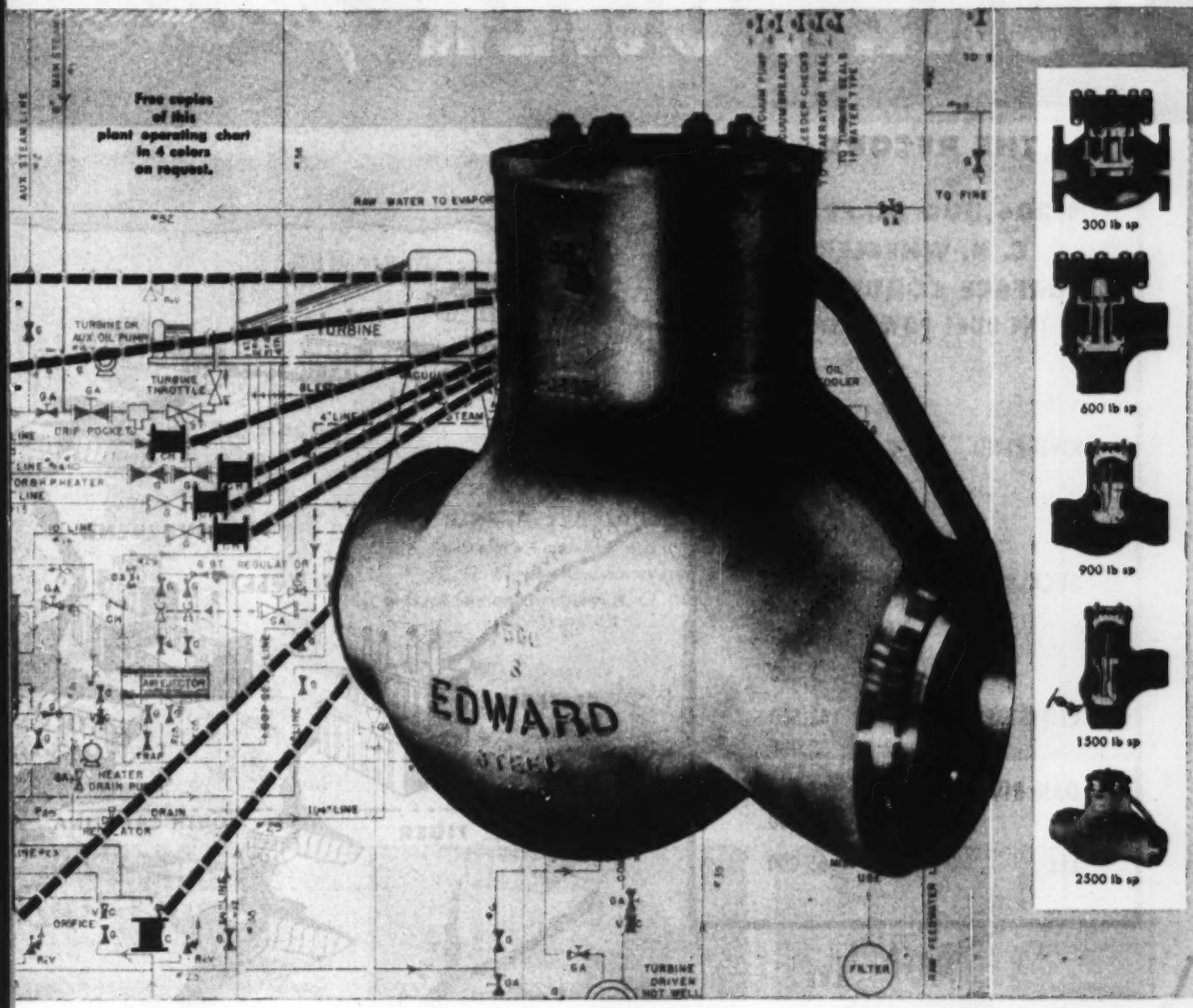
4 High pressure check valves with equalizers require less flow to open. An equalizer is a by-pass which connects the relatively high pressure zone above the disk to the high velocity, low pressure area in the valve outlet creating a semi-vacuum which pulls disk upward. (Every Edward check valve over 600 psi has an Equalizer installed on the right side when facing outlet and the disk seats itself against cover for vibrationless operation and minimum pressure drop.)

5 Avoid gadgety designs that obstruct flow and tend toward increased maintenance. (Edward check valves are simple. Internal contours are streamlined for free flow. Disk is accurately guided by three smooth, self-scouring, integrally cast ribs that insure perfect closures and full, easy openings.)

6 "Cushion closing" check valves protect piping from hammer damage and reduce wear. (Edward "piston" check valves are designed for quick "cushion closing" without damaging shock.)

7 In severe services, integral seats eliminate the possibility of leaks behind screwed or welded-in seat rings. (Edward check valves above 600 psi all have integral Stellite hard surface seats applied in a continuous ring directly to the valve body.)

CHECK VALVES*



BOILER CODE REQUIREMENTS . . . that control check valves:

P-317

(a) The feed pipe shall be provided with a check valve near the boiler and a valve or cock between the check valve and the boiler, and when two or more boilers are fed from a common source, there shall also be a globe or regulating valve on the branch to each boiler between the check valve and the source of supply. Wherever globe valves are used on feed piping, the inlet shall be under the disk of the valve. (Edward globe and gate valves are designed especially for these services.)

(b) When the supply line to a boiler is divided so as to feed a drum in more than one place or to feed more than one drum, it is recommended that each such branch line be equipped with a stop and a check valve even though the common source is equipped as required by (a).

(c) If a boiler is equipped with duplicate feed arrangements, each such arrangement shall be equipped as required by the rules.

(d) A combination stop-and-check valve in which there is only one seat and disk, and a valve stem is provided to close the valve when the stem is screwed down, shall be considered only as a stop valve, and a check valve shall be installed as otherwise provided. (Edward separated type stop-check valves have two separate disks and seats combined in one body.)

(e) Where an economizer or other feedwater-heating device is connected directly to the boiler without intervening valves, the feed valves and check valves required shall be placed on the inlet of the economizer or feedwater-heating device.

A-61 FEED PIPING

The feed pipe of a steam boiler operated at more than 15 psi maximum allowable working pressure shall be provided with a check valve near the boiler and a valve or cock between the check valve and the boiler, and when two or more boilers are fed from a common source there shall also be a globe valve on the branch to each boiler between the check valve and the source of supply. When a globe valve is used on a feed pipe, the inlet shall be under the disk of the valve. (Edward builds globe, check and gate valves designed for these services.)

INSTALLATION IDEAS . . . that foster dependable check valve operation.

1 When installing piston type check valves always have disk traveling in a vertical plane to minimize danger of "hanging-up" or incomplete closures.

2 Never use a horizontal check in a vertical position.

3 Angle valves often save money as well as installation time when used in place of an elbow.

4 Always install check valves with enough clearance so that cover may be removed for maintenance or repairs.

**One of a series providing condensed information on valve applications in steam power plants.*

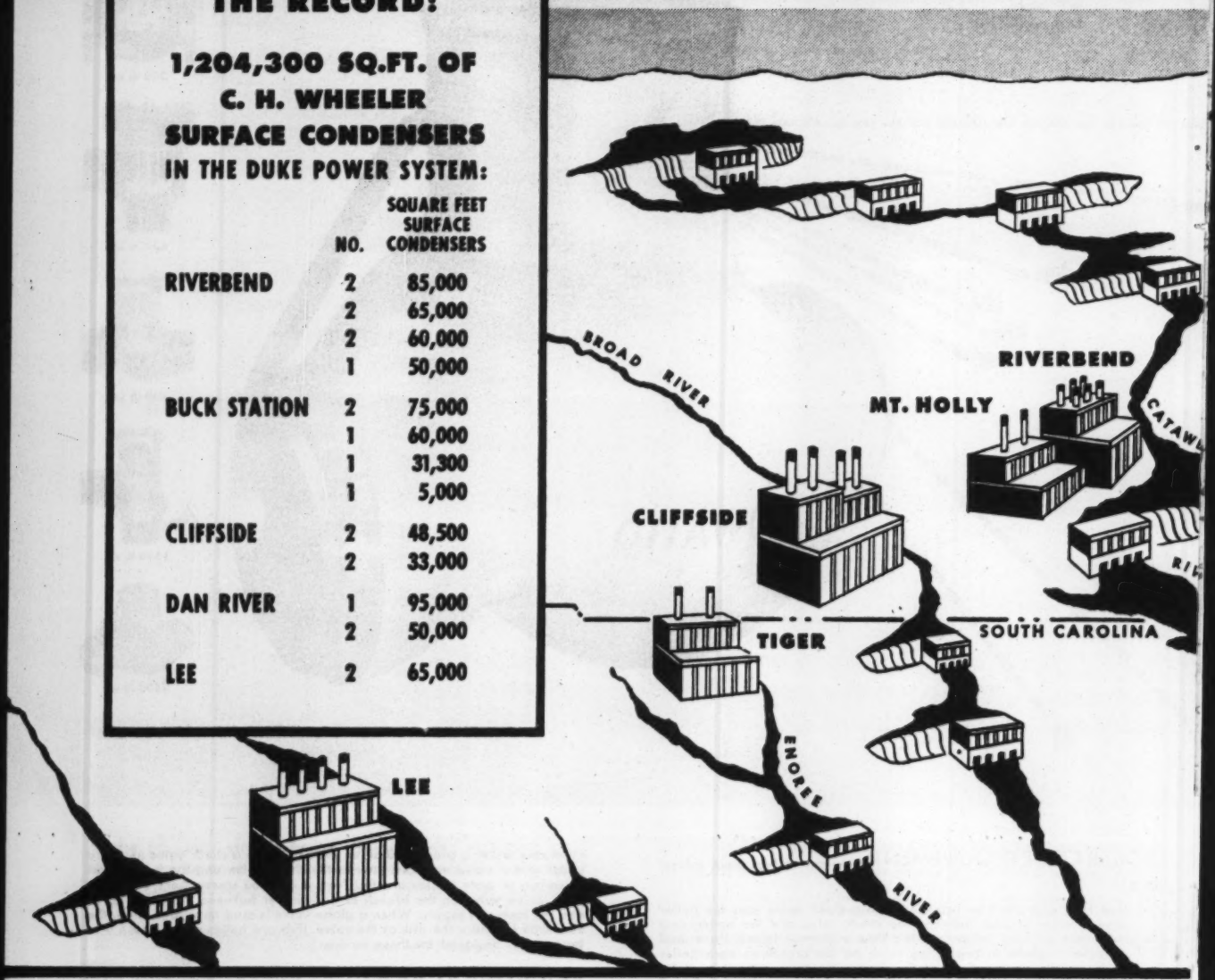
Edward Valves, Inc.
Subsidiary of ROCKWELL MANUFACTURING COMPANY
1350 West 145 St.
EAST CHICAGO, INDIANA
Another Product

DUKE POWER *picks*

THE RECORD:

1,204,300 SQ.FT. OF C. H. WHEELER SURFACE CONDENSERS IN THE DUKE POWER SYSTEM:

	NO.	SQUARE FEET SURFACE CONDENSERS
RIVERBEND	2	85,000
	2	65,000
	2	60,000
	1	50,000
BUCK STATION	2	75,000
	1	60,000
	1	31,300
	1	5,000
CLIFFSIDE	2	48,500
	2	33,000
DAN RIVER	1	95,000
	2	50,000
LEE	2	65,000

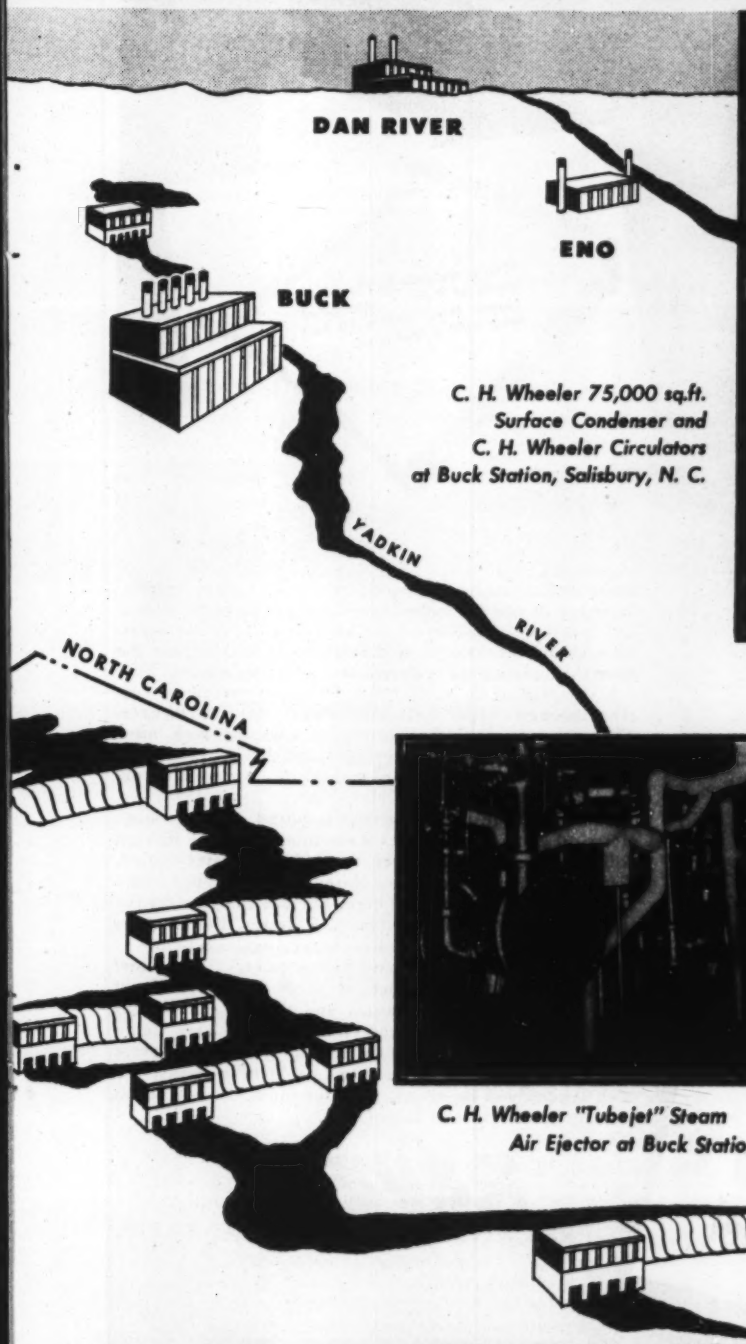


C. H. Wheeler Steam Condensers, Air Ejectors, Circulating and Condensate Pumps are tried and trusted equipment in every new steam power generating station that Duke Power has built. Photos show some of the latest installations in the new Buck Station where five C. H. Wheeler Surface Condensers are installed, ranging in size from a 5000 sq.ft. house turbine unit to a 75,000 sq.ft. unit. All other steam stations on the Duke system are completely equipped by C. H. Wheeler. This equipment is designed to strike a sound balance between first cost, operating efficiency and maintenance costs.

There's progressiveness in C. H. Wheeler engineering that matches the expansion plans of a great utility like Duke Power. A new 95,000 sq.ft. Surface Condenser Unit and auxiliaries is now being manufactured for Dan River Station.

The art of condensing steam and producing vacuum for the prime movers of industry has the seasoning of 50 years of development at C. H. Wheeler. You can find no richer experience . . . no greater vision for the future of steam power generation . . . than at C. H. Wheeler of Philadelphia. . . . *HOW MAY WE HELP YOU?*

C. H. WHEELER
STEAM CONDENSERS—AIR EJECTORS
CIRCULATING AND CONDENSATE PUMPS



C. H. Wheeler 75,000 sq.ft. Surface Condenser and C. H. Wheeler Circulators at Buck Station, Salisbury, N. C.

C. H. Wheeler "Tubejet" Steam Air Ejector at Buck Station

C. H. Wheeler 5-stage Condensate Pumps Operating on a Split Cycle System with a balancing standpipe between stages

C. H. WHEELER *of Philadelphia*

C. H. WHEELER MANUFACTURING CO., 19th & LEHIGH, PHILADELPHIA 32, PENNA.

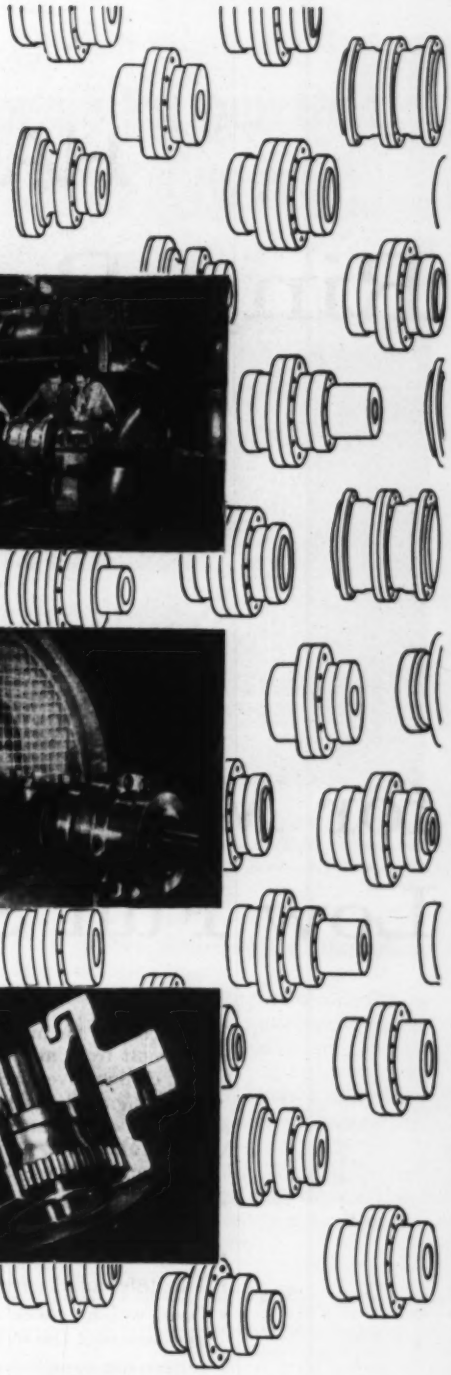
This 25-ton induction stirrer is fastened to the bottom of a 90-ton capacity electric arc furnace.
One of the coils for the stirrer, made of Revere rectangular copper tube. Coil is 12 feet long, over 6 feet wide.
Revere Copper
helps stir molten steel

When steel is produced in an electric arc furnace it is highly desirable to stir the molten metal, to assure uniform heat and avoid stratification of the various alloy constituents. Manual and mechanical methods have been used, but the most modern method is electrical—induction stirring. This is accomplished by sending low-frequency two-phase currents through copper coils immediately under the furnace. The magnetic field thus produced stirs the melt most effectively. Stirring can be reversed, and the contents of the furnace made to flow toward either the slag door or the pouring lip.

Because of the heavy currents required, copper's high electrical conductivity makes it essential. Since the stirring coils are close to the furnace, they must be water cooled, distilled water being used in a closed system. Copper's high thermal conductivity is vital here. The basic copper for the stirrers made by Elliott Company, Ridgway, Pa. for Aros Electric, Inc., New York, is Revere rectangular tube, .945" x .750", .157" wall. Elliott and Revere technical personnel worked closely on the problem of specifications, arriving at joint agreements on tolerances and temper suitable for bending. These proved successful from the start, again showing the value of close collaboration between Revere and its customers . . . If you have a problem in connection with copper and its alloys, and aluminum alloys, consult Revere. See the nearest Sales Office.

REVERE

See why FAST'S Couplings are your wisest buy



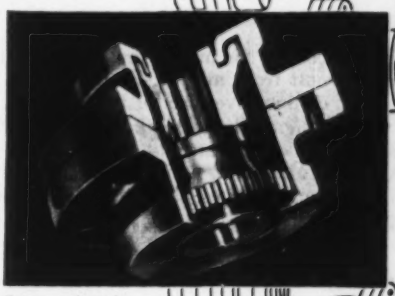
LESS DOWN-TIME. Industry finds that Fast's Couplings, the original gear type coupling, give trouble-free performance. They save on maintenance. Save money (often thousands of dollars in production losses) year in, year out, because there is no down-time due to breakage . . . no expense of replacing perishable parts.

LOWEST COST PER YEAR because Fast's Couplings usually outlast the equipment they connect. Many Fast's Couplings are still in use after 30 years. Why? Because they are ruggedly constructed of the sturdiest, most practical materials . . . all steel in construction, unique in design.

FREE ENGINEERING SERVICE. The same "Know-how" that goes into the manufacture of famous Fast's Couplings . . . that has resulted in over three-fourths of a million successful installations . . . applies to its extensive engineering service. 35 years of experience in developing the most satisfactory materials and designs, means our staff is well prepared to give you the most effective and cost-saving solutions to your coupling problems. Just outline and send them to Koppers for assistance. And send for free catalog. Just mail the coupon below.

Fast's Coupling installation in a modern power plant.

Close-up of Fast's Coupling, linking power to industrial fan.



Cutaway view of typical Fast's Coupling. Note unique design.

THE ORIGINAL

FAST'S Couplings

KOPPERS

METAL PRODUCTS DIVISION • KOPPERS COMPANY, INC. • BALTIMORE, MD. This Koppers Division also supplies industry with American Hammered Industrial Piston and Sealing Rings, Koppers Electrostatic Precipitators, Aeromaster Fans and Gas Apparatus. *Engineered* Products Sold with *Service*

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Gentlemen: Send me a Free, Fast's Catalog giving detailed descriptions, engineering drawings, capacity tables and photographs.

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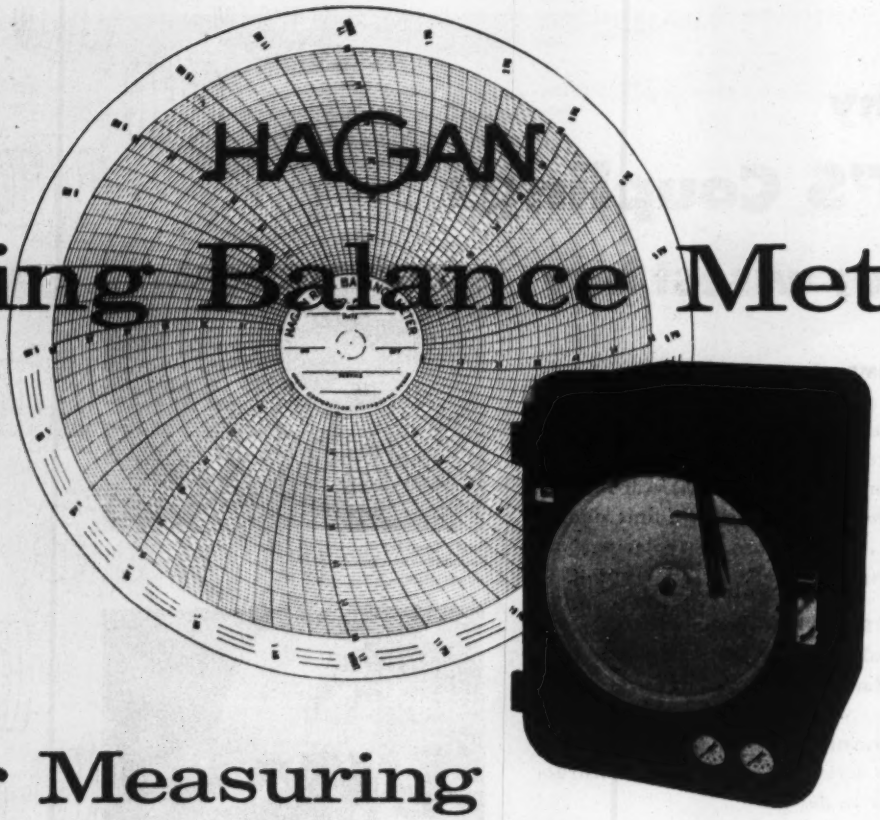


Ring Balance Meters for Measuring Low Full Scale Differentials

The necessity for measuring flows, with only a low full scale differential available, may result from any of several factors. Type and location of the source of differential, or lines oversize for the flow rate, are encountered most frequently.

The Hagan Ring Balance Meter is particularly adapted for accurate operation at full scale differentials as low as 1″ WC, with any type of primary element—venturi tube, weir, flume, orifice plate or flow nozzle.

For such services, the Hagan Ring Balance Meter has these advantages:

- There is a complete series of interchangeable sensing elements for full scale differentials from 1″ to 420″ WC at static pressures up to 3000 psig.
- Ring assemblies are always selected to have ample power at all flow rates.
- The differential measuring range of any ring is adjustable over 7 to 1 range.
- Dead weight check of calibration takes only a few minutes. It is not necessary to disconnect the meter from the line.
- Automatic compensation for such factors as fluid density, pressure and temperature is a standard attachment.
- Pneumatic or electric transmission is available for remote recording or for automatic control.

Hagan engineers are prepared to suggest the instruments best suited for new construction or modernization and extension of existing facilities.

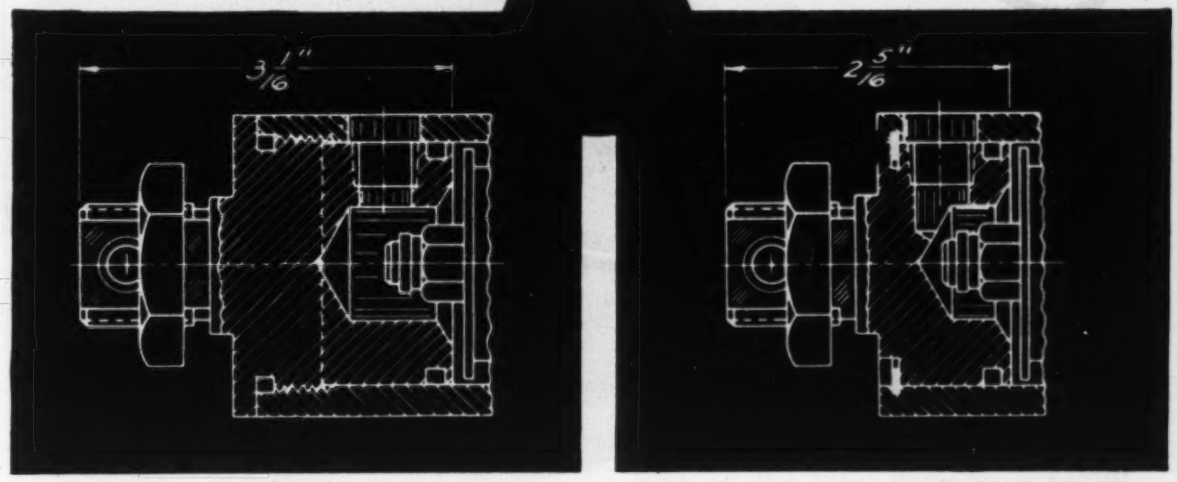
HAGAN HALL BUROMIN CALGON

HAGAN CORPORATION

HAGAN BUILDING PITTSBURGH 30, PENNSYLVANIA

Boiler Combustion Control Systems, Ring Balance Flow and Pressure Instruments, Metallurgical Furnace Control Systems, Control Systems for Automotive and Aeronautical Testing Facilities

Waldes Truarc Rings Cut Costs $3.26 per Unit, Reduce Size and Weight of Air Cylinder!



OLD STYLE air cylinder, with thread-secured head, required costly tapping, chasing and assembly operations. Also, satisfactory maintenance of packing unit necessitated use of pipe wrenches on painted surfaces.

NEW cylinder head is secured with precision-ground Waldes Truarc Rings. This produces perfect alignment of head within the housing, difficult to obtain with screw-thread seating. Maintenance is quick and easy.

WALDES TRUARC RINGS PERMITTED THESE SAVINGS

Production Time Cut..17 minutes
Weight Saved.....1¾ lb.
Length Shortened.....1½ inches
Cost Saved.....$3.26 unit

■ The A. K. Allen Company of Brooklyn, New York, maker of *AllenAir* cylinders, now uses two Waldes Truarc Inverted Rings (series 5008) to secure heads rigidly within tubes.

■ TRUARC Rings, in this application, are ground parallel by A. K. Allen to .001 tolerance. In a static hydraulic bursting test, the 3" unit (recommended for 350 p.s.i.) withstands a pressure of 2000 p.s.i. And at bursting-point, the brass groove gives way; the Truarc Ring remains intact.

■ Waldes Truarc Retaining Rings are precision-engineered . . . quick and easy to assemble and to disassemble. They can be used over and over again. There's a Waldes Truarc Ring to answer every fastening problem.

■ Find out what Waldes Truarc Retaining Rings can do for you. Send your blueprints to Waldes Truarc engineers.

For precision internal grooving and undercutting . . . Waldes Truarc Grooving Tool

SEND FOR NEW CATALOG

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REG. U. S. PAT. OFF.
RETAINING RINGS

WALDES KOHINOOR, INC., LONG ISLAND CITY 1, NEW YORK

WALDES TRUARC RETAINING RINGS AND PLIERS ARE PROTECTED BY ONE OR MORE OF THE FOLLOWING U. S. PATENTS: 2,382,947; 2,382,948; 2,416,852; 2,420,921; 2,428,341; 2,439,785; 2,441,848; 2,455,165; 2,483,380; 2,483,383; 2,487,802; 2,487,803; 2,491,306; 2,509,081; AND OTHER PATENTS PENDING.

ME 056

Waldes Kohinoor, Inc., 47-16 Austel Pl., L. I. C. 1, N. Y.

Please send me the new Waldes Truarc Retaining Ring catalog.

(Please print)

Name.....

Title.....

Company.....

Business Address.....

City..... *Zone*..... *State*.....

DOW CORNING
SILICONES

give motors more muscles

"Class H takes harder abuse, gives longer motor life"

Automatic Transportation Company commands attention in a buyers' market with the new "Dynamotive", the first gas-powered, electrically driven fork lift truck. It incorporates many new features including an electrical system that is interlocked to reduce wear and abuse by making it impossible to reverse the direction of the truck while it is in motion.

Engine wear and fuel consumption are minimized by an electrical transmission with its inherent overdrive feature that automatically adjusts engine speed to load requirements. The engine and the motor always run at the most efficient speed.

Generator and motor drive of the "Dynamotive", like all Automatic motors built since 1946, are wound with silicone (class H) insulation. Automatic Transportation engineers report that: "silicone insulation is used because it contributes to longer life and can take harder abuse than other insulating materials. Since we adopted it 7 years ago, we have never, to our knowledge, lost a motor due to insulation failure."

That's the kind of performance that has convinced more and more designers, maintenance and management men of the value of Class H insulation made with Dow Corning silicones. In thousands of applications, from sub-miniature electronic assemblies to 1000 hp industrial motors, Class H is delivering up to 50% more power per pound and outlasting conventional insulation by 10 or more times.

If your electrical equipment must give superior performance to meet stiffer competition, take a tip from leaders in the field: redesign to capitalize on the longer life and greater reliability inherent in Silicone Insulation.

Increase efficiency, cut production and maintenance costs; specify Silicone (Class H) Insulation

mail this coupon Today!

DOW CORNING CORPORATION, Dept. Q-17, Midland, Michigan

Please send me:
- ☐ Performance data on Class H equipment
- ☐ Data on Silicone Grease for motor bearings
- ☐ Catalogs of Class H Insulating materials
- ☐ 32-page booklet entitled "What's A Silicone?"

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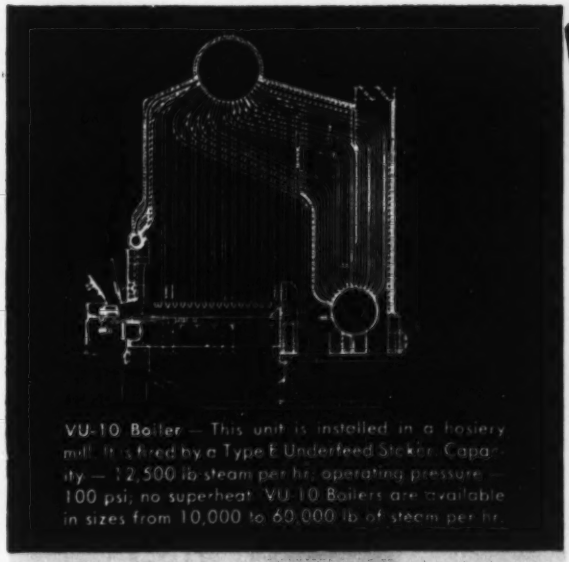
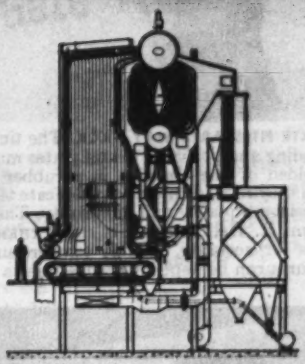
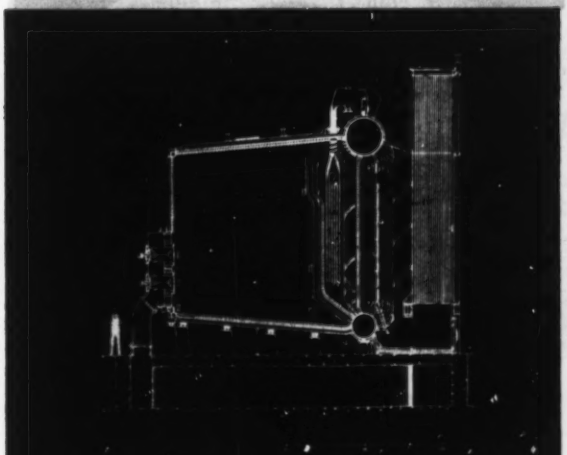


VU-10 Boiler — This unit is installed in a hosiery mill. It is fired by a Type E Underfeed Stoker. Capacity — 12,500 lb steam per hr; operating pressure — 100 psi; no superheat. VU-10 Boilers are available in sizes from 10,000 to 60,000 lb of steam per hr.



VU-40 Unit — One of seven, recently installed in a Chemical Plant. These boilers are fired with C-E Spreader Stokers (continuous discharge type). The capacity of each is 60,000 lb of steam per hr at an operating pressure of 325 psi. There is no superheat.



VU-50 Boiler — This unit is one of two duplicates installed in a brewery. They are fired with oil or gas. Capacity — 100,000 lb of steam per hr; operating pressure 550 psi; steam temperature 700 F. This particular design is of the bottom supported type.

VU Utility Standards in a Standard Boiler

Electric utility companies maintain the highest equipment standards in the power generation field. Kilowatts are their business — their product... to be turned out reliably, efficiently and at the lowest possible cost. To assure this they demand — and get — the most reliable — the most efficient — the best built boilers that the market affords.

To meet their highly critical standards the utilities have long been accustomed to purchase steam generating units that were, in large measure, individually designed to meet their particular needs. And C-E Vertical-Unit Boilers, particularly in the larger sizes, are available in "custom-made" designs to suit specific requirements. In fact, VU Units have been a popular choice with utility companies for many years.

But many other designs that comprise the "VU family" are completely *standardized*...standardized without sacrifice of "custom-made" advantages. And when you standardize you reduce engineering costs, reduce manufacturing costs, reduce erection costs — in short, you save money.

Here then is a line of custom-quality boilers with all the benefits of standardization built in capacities from 10,000 lb of steam per hr up, for any pressure and temperature...and suitable for any type of fuel burning equipment.

Little wonder that industry — all industry — has found within the VU family a boiler unit exactly suited to its needs. Breweries and hosiery mills, chemical companies and steel plants — all have installed VU Boilers again and again with complete satisfaction. So can you. B-649A

COMBUSTION ENGINEERING, INC.

Combustion Engineering Building

200 Madison Avenue, New York 16, N. Y.

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT

How would YOU solve these two problems?

1. A PATCH AHEAD OF TIME, applied at the factory, reinforces the knees of dungarees and overalls. Patches are vulcanized under pressure with Radio Frequency Corp.'s high frequency, dielectric heater. If dielectric heat, generated in the material, is lost through conduction, vulcanization becomes inefficient. But Fenwal THERMOSWITCH® units in each platen minimize these losses by close temperature control. Vulcanizing 3000 patches per hour is now standard; 30 was.

2. DENTAL PLATE FIT STARTS WAY BACK. The tiny abrasive wheels for grinding and polishing dental plates must be very accurately molded of fine abrasive in a rubber base. The molds in which they're made must have delicate temperature control for consistent quality and uniformity. The manufacturer, The Wm. R. Hall & Son Co., uses THERMOSWITCH units in molds for accurate, reliable temperature control. Production figures can be kept high while rejects are low.

3. THIS IS IT — the Fenwal THERMOSWITCH control is simple — compact shell contracts or expands *instantly* with temperature changes, opening or closing electrical contacts. Adjustable and highly resistant to shock and vibration. Fenwal THERMOSWITCH units are solving temperature problems and helping to improve the final product throughout all industry.

4. SEND FOR THIS BROCHURE for complete explanation of the unique THERMOSWITCH unit. Also ask for more detailed, illustrated discussions of the problems above. Fenwal engineers will be glad to help you solve your temperature control problems involving heat, humidity, radiant heat, pressure and other variables. Write Fenwal Incorporated, 56 Pleasant St., Ashland, Massachusetts.

Fenwal

THERMOSWITCH®

Electric Temperature Control and Detection Devices

SENSITIVE... *but only to heat*

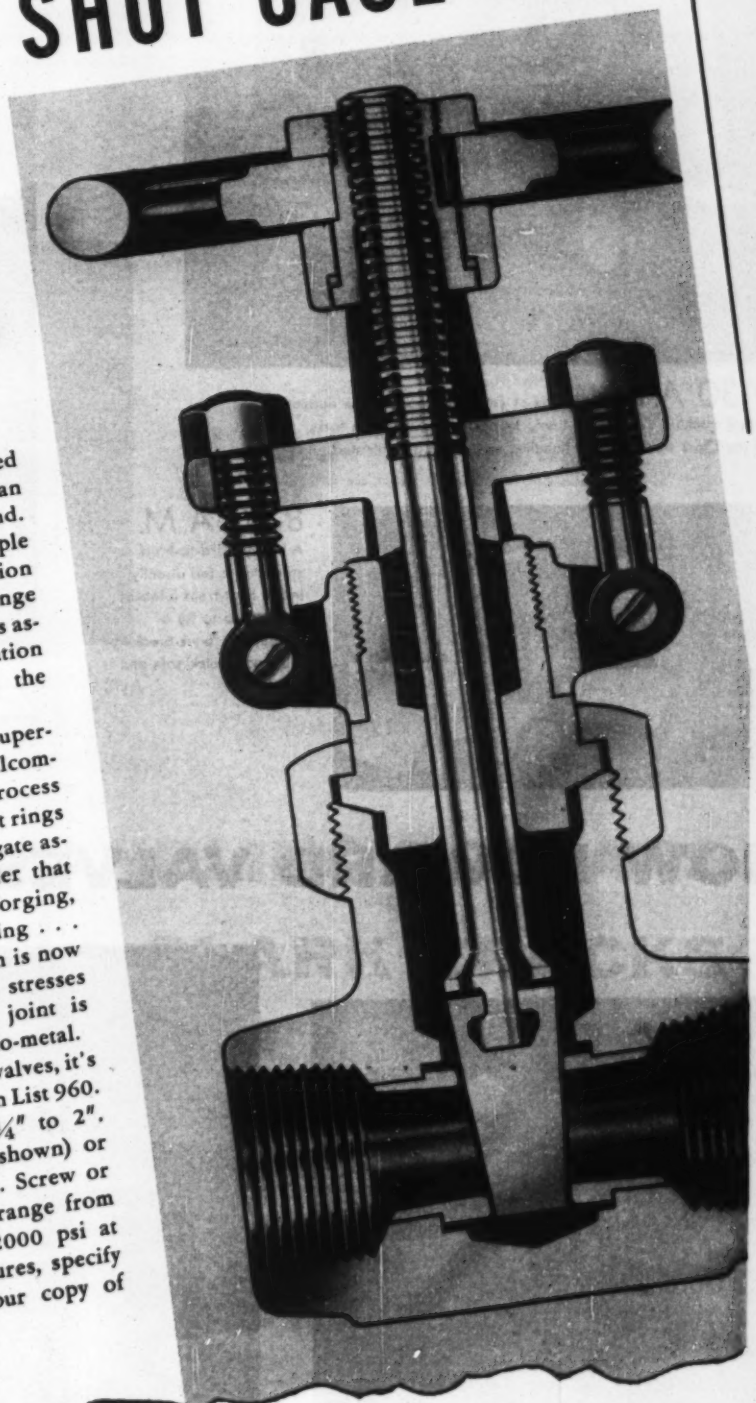
OPEN AND SHUT CASE FOR CHAPMAN LIST 960

Small Forged Steel Gate Valves

Chapman List 960 is used for more different jobs than any other valve of its kind. And no wonder: its simple and rugged construction means reliability over its wide range . . . super-hardened gate and seats assure tight closure, smooth operation and low maintenance under the toughest conditions.

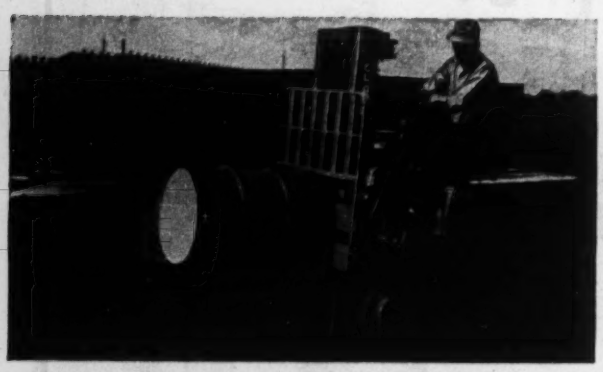
Here's why: gate faces are super-hardened to 800 Brinell by Malcomizing, Chapman's exclusive process . . . hardened stainless steel seat rings are replaceable . . . stem-and-gate assembly has a tapered shoulder that seats snug in the bonnet forging, permits full-pressure repacking . . . the stem-and-gate connection is now 50% stronger where high stresses can develop . . . bonnet joint is gasketed or ground metal-to-metal.

For big savings on small valves, it's a winning case for Chapman List 960. Available in sizes from ¼" to 2". Rising stem, with yoke (shown) or inside screw, rising stem. Screw or welding ends. Pressure range from 380 psi at 1000°F to 2000 psi at 100°F. For higher pressures, specify List 990. Write for your copy of Catalog 10 now.



The **CHAPMAN VALVE**
MANUFACTURING COMPANY
Indian Orchard, Mass.

A Day in the Life of a Clark Fork Truck



7:30 A.M. A barrel of cutting oil goes to the automatic screw machine department firmly supported between the forks of the Clark truck. Special handling equipment is eliminated.

8:40 A.M. A heavy, hard-to-hoist steel slab is fed directly into a heat-treat furnace. What used to be a dangerous, back-breaking job is now quick, safe and easy.

9:12 A.M. Rough castings of valve bodies are picked up from outside (overhead) storage for delivery to boring mills. The Clark electric truck is just as efficient on good surfaces outdoors as inside.

HOW EDWARD VALVES, Inc., SAVES

9:05 A.M. Clark truck dumps tote box of forgings into heat treating basket. Filling a basket, each of which holds 1500 to 2000 lbs., takes less than three minutes.

10:00 A.M. The Maintenance Department calls for the Clark to replace a fluorescent tube in a high fixture. No more two-man teams to carry and hold a ladder; far less chance of an accident; big saving in time.

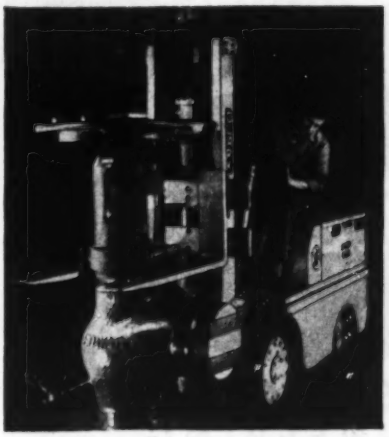
10:30 A.M. Cutting set-up time for positioning a new die in a forge-shop hammer —a Clark fork truck with only one man to guide the die. The Clark moves in easily where ordinary hoists are difficult to use.

11:20 A.M. Back to work for the maintenance department, the Clark truck moves a welding machine to a new location. At least one Clark truck is always ready for off-shift maintenance jobs.

3:20 P.M. Into a highway trailer truck goes a load of valves for shipment. Direct, one-operation truck loading means savings in the shipping department, quicker conversion of finished orders into billings.

1:10 P.M. In the finished parts stores department the Clark high-stacks a tote box of parts from the lathes. Edward conserves valuable production floor space by cubic-foot, instead of square-foot, storage.

MATERIALS HANDLING DOLLARS BY USING CLARK TRUCKS



2:35 P.M. A finished valve goes to the shipping department. Using Clark trucks eliminates many skidding operations, cuts crating costs for Edward Valves.

"We've declared war on materials handling costs," says W. F. Crawford, President of Edward Valves, Inc., East Chicago, Ind., Subsidiary of Rockwell Manufacturing Co. "Every day we're studying another handling operation to see if there isn't a quicker way to do it with less fatigue for the workman and lower costs."

"Clark trucks—both electric powered fork trucks and ***POWR-WORKER*** hand trucks—are a key weapon. We've used Clarks for 12 years, because they cost less to operate and do more jobs. Versatility is important in a plant our size; to really save money with lift trucks you've got to keep them busy doing many different operations."

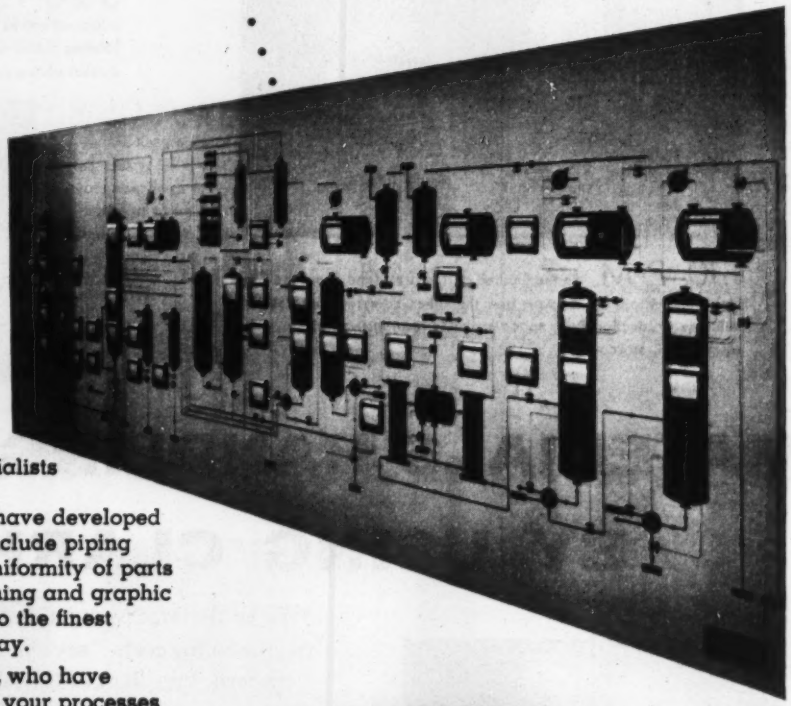
Here are a few of the dozens of operations on which Edward Valves, Inc., has cut profit-eating indirect costs by using Clark Equipment.

INDUSTRIAL TRUCK DIVISION
CLARK EQUIPMENT COMPANY
BATTLE CREEK 88, MICHIGAN

CLARK EQUIPMENT

engineered GRAPHIC PANELS

by FOXBORO



Working as a team, Foxboro Panel and Process Control Engineers offer you an unequalled resource . . . one which will assure you of the most efficient instrumentation, and the most practical panel layout, for your process.

Foxboro Panel Engineers are specialists in panel design and fabrication. Exclusive techniques which they have developed over many years of experience include piping arrangements, wiring methods, uniformity of parts and accessories, methods of finishing and graphic portrayal — all of which add up to the finest graphic panel work available today.

Foxboro Process Control Engineers, who have specified the right instruments for your processes over the years, are applying this valuable experience to the integrated control systems which you require today.

Whether we originate the graphic layout from your flow sheet, or work directly from a design of your own, this engineering teamwork will provide you with the ultimate in an operating panel for centralized process control.

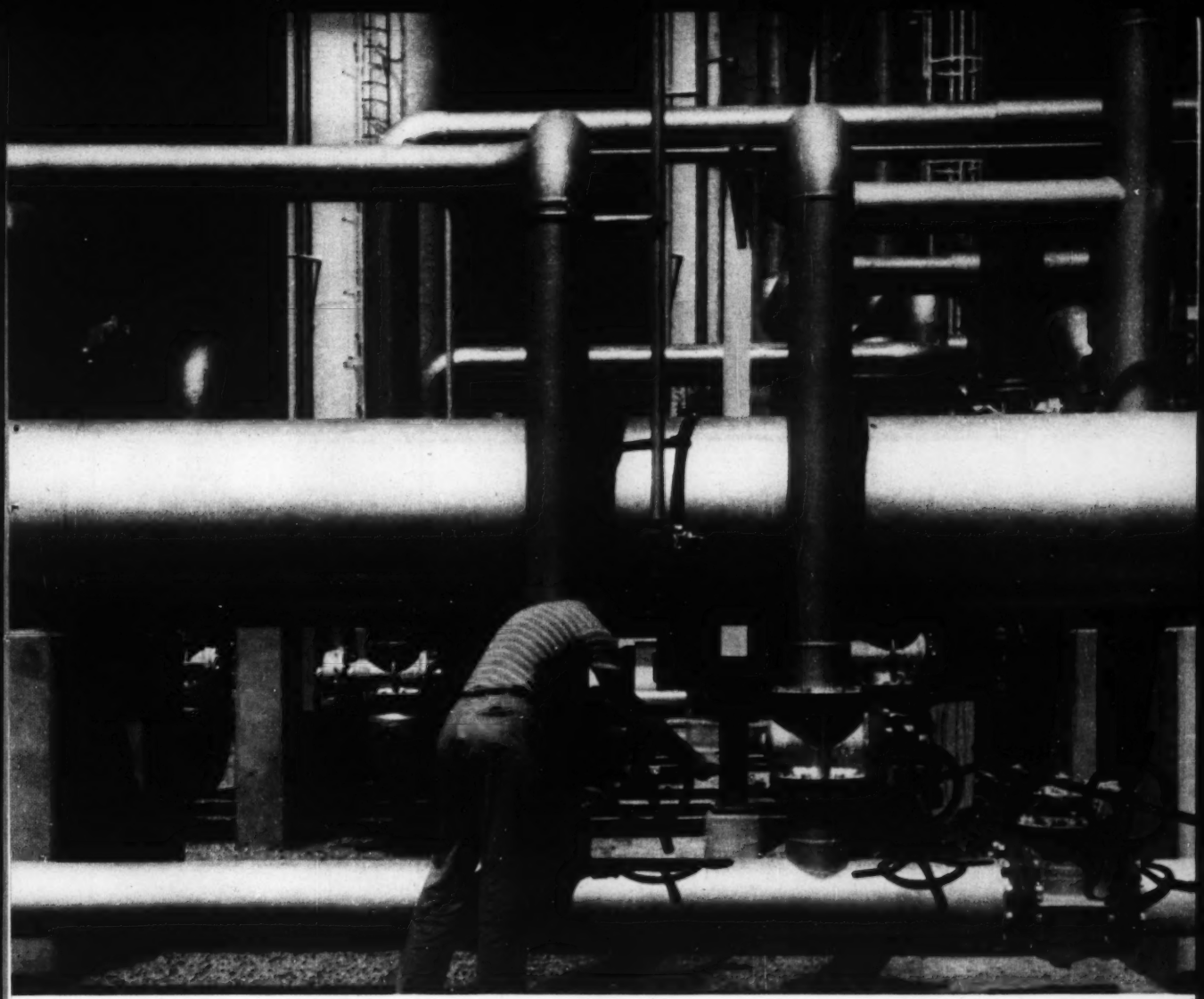
If you are planning a new or modernized control room, let us detail a proposal for you, with comprehensive data on Foxboro Graphic Panels.

The Foxboro Company, 364 Neponset Ave., Foxboro, Mass., U.S.A.

FOXBORO
REG U S PAT OFF

PROCESS CONTROL ENGINEERING

FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND



HOW QUICK CAN YOU CLOSE A VALVE?

That depends on the size and type of valve, of course. But with a Rockwell-Nordstrom valve it's only a quarter-turn eased by a film of lubricant.

Another thing—with simple maintenance a Nordstrom valve will never stick or leak in an emergency. The same lubricant that makes turning easy is also a hydraulic jack to free the plug, and at the same time is a leak-closing pressure seal around the valve ports.

Specify the original lubricant seal valve. There's no substitute for Rockwell experience—use it to save money on valves. *Rockwell Manufacturing Co., Pittsburgh 8, Pa.*

THREE WAYS THE NORDSTROM LUBRICANT WORKS

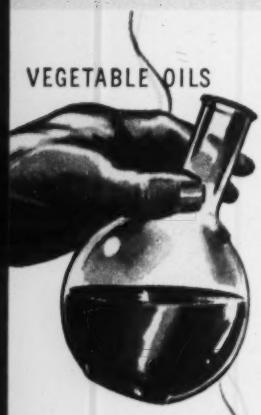
1. Lubricant surrounds each valve port with a vapor tight pressurized seal. **Nordstrom valves stay tight.**
2. Lubricant acts as hydraulic jack—a fast quarter-turn to open or close. **Nordstrom valves operate quickly.**
3. Lubricant coats the plug for sliding action—no wear-producing wedging. **Nordstrom valves operate easily.**

Rockwell Built

NORDSTROM VALVES

Lubricant-Sealed for Positive Shut-Off

WHAT DO THESE LIQUIDS HAVE IN COMMON?

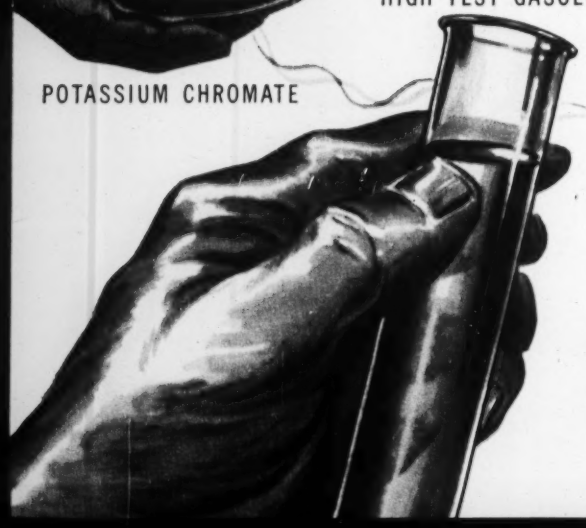


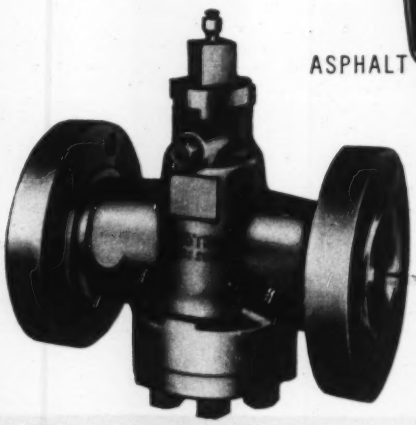
They differ widely in viscosity, volatility and other physical characteristics . . . Yet they are all successfully controlled by Rockwell-Nordstrom lubricant-sealed valves.

Nordstrom adaptability for all these—and hundreds of other—difficult liquid services lies in the basic Nordstrom design. The system of internal valve grooving, patented by Nordstrom, distributes lubricant around the valve ports for a pressure-tight seal. The same lubricant gives a bearing surface for easy operation, prevents the grinding wear of metal-to-metal contact, and acts as a hydraulic jack.

Nordstrom is the first and by far the most complete line of lubricated plug valves. Rockwell engineers can help you fit the right valve and the correct, tested genuine Nordstrom lubricant to your process.

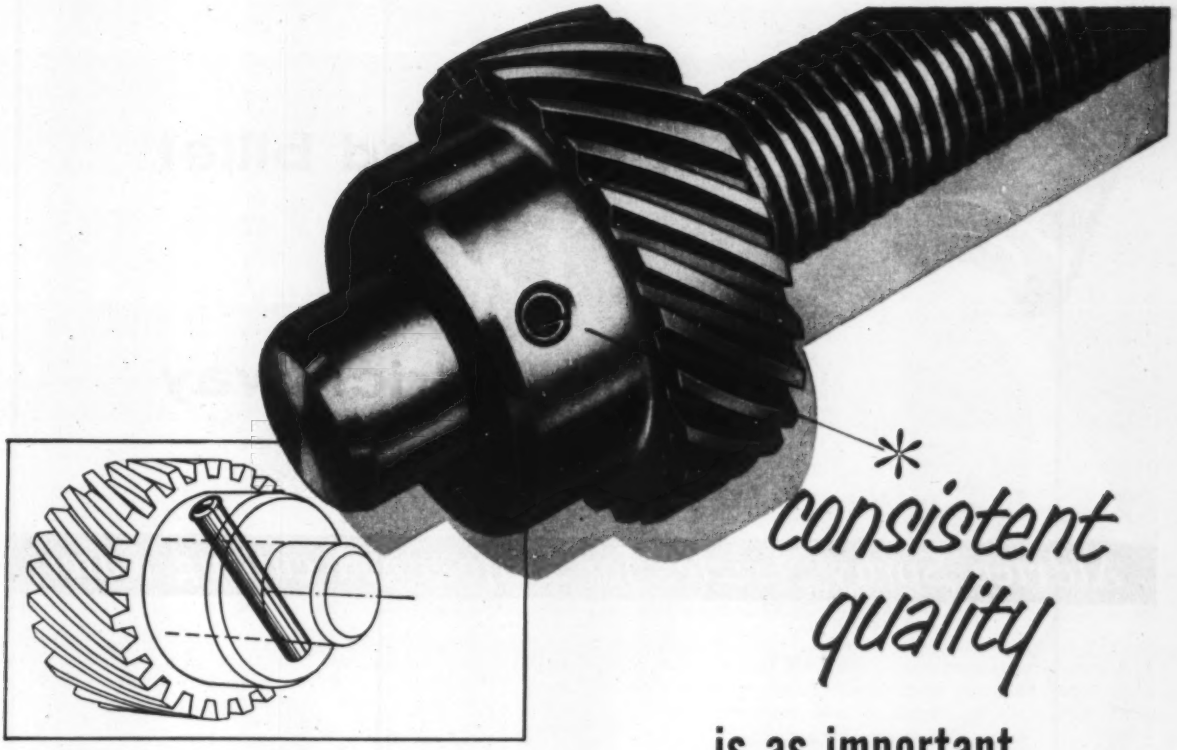
Rockwell Manufacturing Company, Pittsburgh 8, Pa.





Nordstrom Valves

Another Quality ROCKWELL Product



*consistent quality

is as important in the pin as in the gear

To function effectively, a spring pin must drive easily into holes drilled to normal production tolerances, compressing as driven. To drive easily, hold firmly and fit flush, the pin —*every* pin—must meet the strict requirements of specifications such as those prepared by the SAE and the Military Services.

Since failure of a pin can be as costly as a failure of any other precision part, it is important to check the pins *you* buy for uniformity . . . uniformity of diameter and length, shear strength, hardness, insertion and removal forces, and recovery of diameter.

Rollpin has been tested many times—by many manufacturers—with a consistently high performance record. It has been widely recognized as the "quality" fastener of its type. In this case, quality can be—and should be—measured. We strongly urge that you test for quality when buying spring pins.

ELASTIC STOP NUT CORPORATION OF AMERICA

Dept. R28-511, Elastic Stop Nut Corporation of America
2330 Vauxhall Road, Union, New Jersey

Please send the following free fastening information:

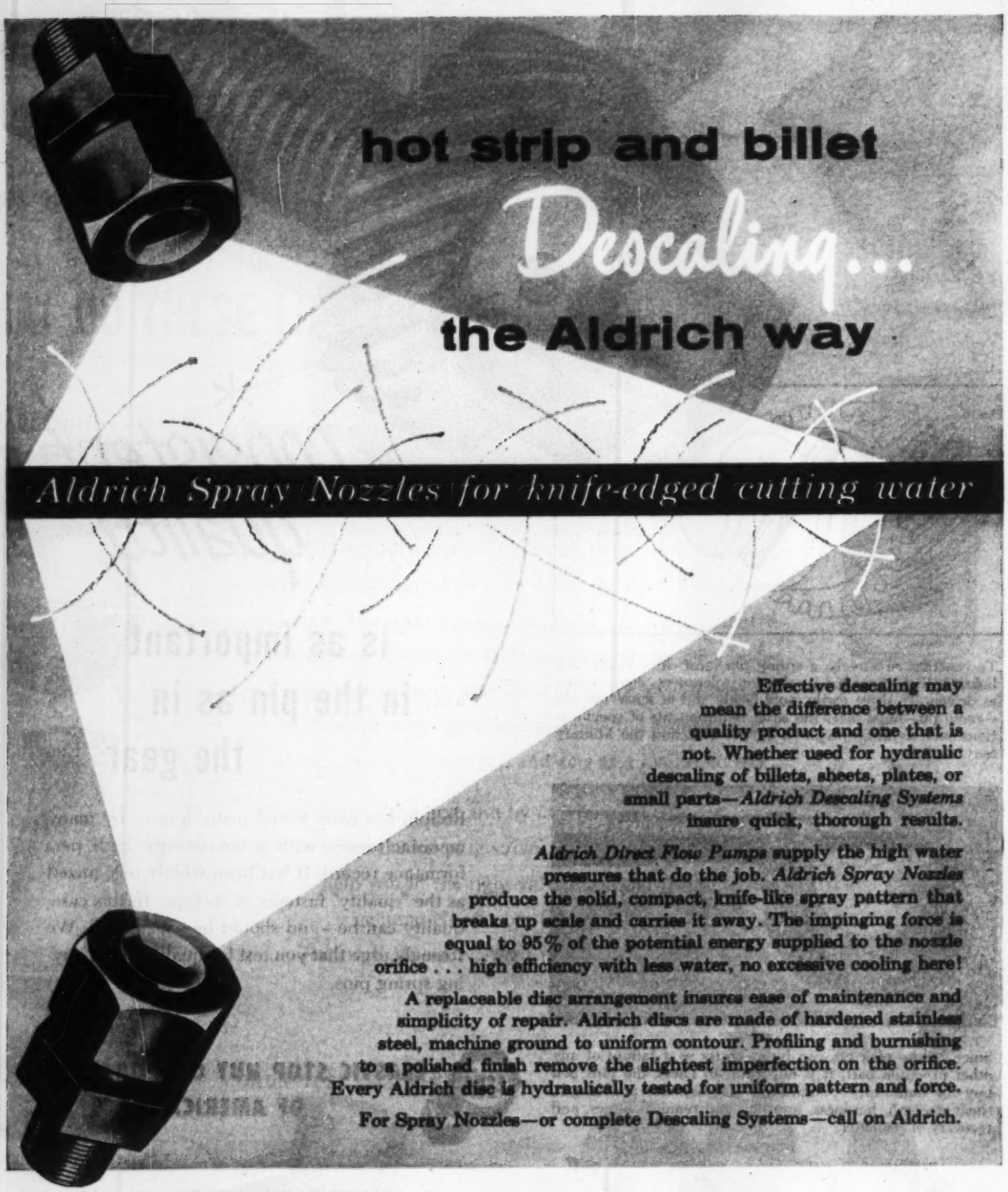
☐ Rollpin samples
☐ Rollpin bulletin
☐ Here is a drawing of our product. What self-locking fastener would you suggest?

Name_____ Title_____

Firm_____

Street_____

City_____ Zone____ State_____


hot strip and billet
Descaling...
the Aldrich way
Aldrich Spray Nozzles for knife-edged cutting water
Effective descaling may mean the difference between a quality product and one that is not. Whether used for hydraulic descaling of billets, sheets, plates, or small parts—Aldrich Descaling Systems insure quick, thorough results.
Aldrich Direct Flow Pumps supply the high water pressures that do the job. Aldrich Spray Nozzles produce the solid, compact, knife-like spray pattern that breaks up scale and carries it away. The impinging force is equal to 95% of the potential energy supplied to the nozzle orifice . . . high efficiency with less water, no excessive cooling here!
A replaceable disc arrangement insures ease of maintenance and simplicity of repair. Aldrich discs are made of hardened stainless steel, machine ground to uniform contour. Profiling and burnishing to a polished finish remove the slightest imperfection on the orifice. Every Aldrich disc is hydraulically tested for uniform pattern and force.
For Spray Nozzles—or complete Descaling Systems—call on Aldrich.

the ALDRICH pump company

29 PINE STREET • ALLENTOWN, PENNSYLVANIA

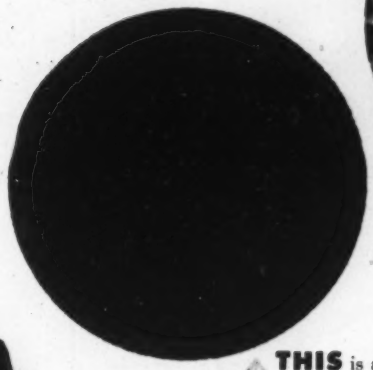
. . . Originators of the Direct Flow Pump

Representatives: Birmingham • Bolivar, N. Y. • Boston • Buffalo • Carmi, Illinois • Charleston, W. Va. • Chicago • Cincinnati • Cleveland • Dallas • Denver • Detroit • Duluth Houston • Los Angeles • New York • Oakland, Calif. • Philadelphia • Pittsburgh • Portland, Ore. • Richmond, Va. • Rochester • Salt Lake City • San Francisco • Seattle Somerville, Mass. • Spokane, Wash. • Syracuse • Tulsa • Washington, D. C. • Youngstown • Export: Petroleum Machinery Corp., 30 Rockefeller Plaza, New York 20, N. Y.

You don't need 3-D glasses

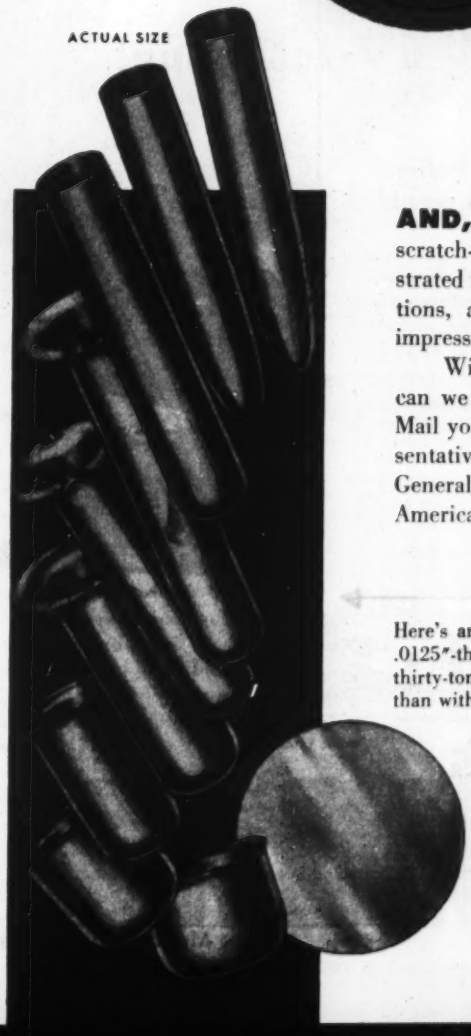
to see the difference

THIS is a 75X magnification of ordinary drawing brass—the kind that's been used for decades for stamped or drawn brass products.



THIS is a 75X magnification of super-fine-grain Formbrite.* Isn't it obvious that this new type of brass can be polished in half the time? Frequently, a simple color buff will bring up the desired finish for lacquering or plating.

ACTUAL SIZE



AND, Formbrite is harder, stronger, springier and more scratch-resistant than ordinary drawing brass, yet has demonstrated its remarkable ductility for forming and drawing operations, and ability to take sharp, clean-cut ornamental die impressions.

With all these advantages, Formbrite costs no more. What can we do to help you try this time and cost-saving metal? Mail you a booklet? Send you a sample? Ask our Sales Representative to call? Simply write to The American Brass Company, General Offices: Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario, Canada.

*Reg. U. S. Pat. Off. 5485

Here's an example of Formbrite at work. These pen caps are made of .0125"-thick Red Brass Formbrite strip at the rate of 2,000 an hour on a thirty-ton, 10-step multiple plunger press. Caps are buffed at a higher rate than with any other metal previously used.

Formbrite **DRAWING BRASS**

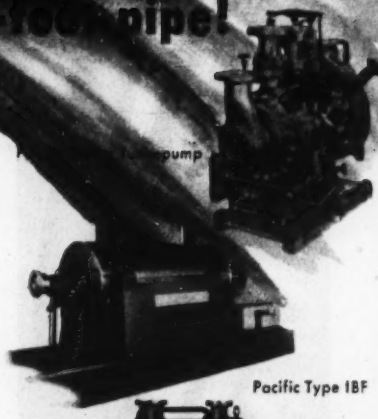
an **ANACONDA®** Product

made by The American Brass Company

It takes a lot of water to fill a 7-foot pipe!

To bring the hot water to all the Pacific Boiler Feed Pumps placed in operation in 1953 would require a pipe 7 feet in diameter...

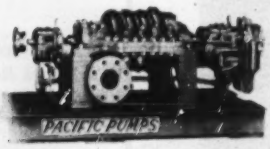
Today practically all of the large power generating companies throughout the United States have one or more Pacific Pumps in feed water service. Pacific Boiler Feed Pumps now operating include small vertical type units handling 47,700 pounds per hour at 710 psig discharge pressure—to very large horizontal type units handling 800,000 pounds per hour at 2430 psig discharge pressure. Bulletins 106, 109 and 118 giving details available on request.



Pacific Type IBF

Pacific Type ABF

Specify **Pacific CENTRIFUGAL BOILER FEED PUMPS**

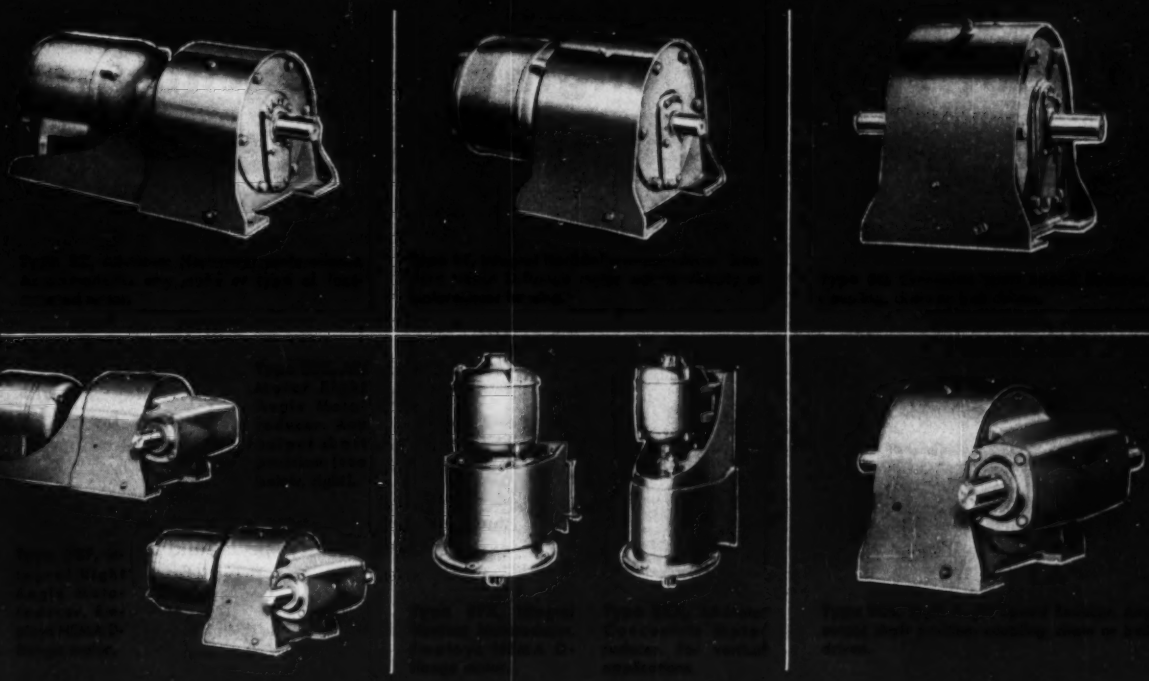


Pacific Type JBF

Pacific Pumps inc. HUNTINGTON PARK, CALIFORNIA
ONE OF THE DRESSER INDUSTRIES
Export office: Chanin Building, 122 East 42nd Street, New York
Offices in all principal cities

BF-19

ALL-STEEL FALK Motoreducers



VERSATILE MEMBERS OF A DISTINGUISHED FAMILY

The name FALK on a reducing unit of any size or type is a positive guarantee of highest quality, value and efficient performance with minimum maintenance throughout its long life.

All-steel FALK Motoreducers—both the All-Motor and Integral types—are available in horizontal and vertical models with double, triple or quadruple reduction; concentric and right-angle shaft arrangements. They cover a surprisingly wide range in horsepowers and in output speeds. Every FALK Motoreducer is built and rated according to AGMA standards.

Whatever reduction requirements are involved in the industrial equipment you manufacture, it is just good business to consult FALK, recognized leader in the Motoreducer and speed reducer field. Write to Department 247.

Every FALK Motoreducer has these "IN-BUILT" Factors

All-steel Housings. Unbreakable, strong, rigid. Generous overhung load capacities provided by wide bearing spans, large shafts and bearings.

Precision Gearing. Heat-treated alloy steel, precision cut and shaved helical gearing throughout . . . quiet-operating crown shaved pinions . . . taper bored gears for easy ratio changes.

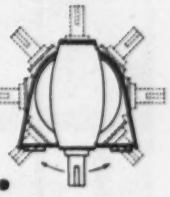
Sealed Housings. Dual closures and one-way vents keep oil in, dust and moisture out. Units are splashproof, leakproof, dustproof.

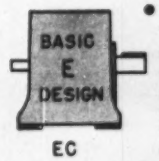
Wide Speed Range. Selective ratio combinations provide output speeds from 1.5 rpm to 1430 rpm with stock gears.

Streamlined inside and outside. Smooth, clean surfaces; machine welded construction conforms to NEMA motor frames.

Positive Lubrication. Large sump capacity . . . oil-tight construction assures clean lubricant . . . direct dip of revolving elements provides positive lubrication at all speeds.

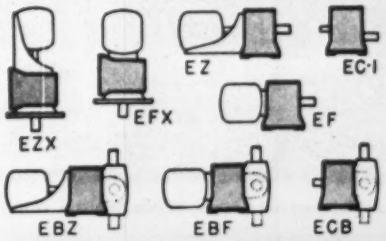
Any Output Shaft Arrangement (on Right Angle models). Shafts can be furnished in horizontal, vertical or angle position as shown in sketch at right.





EC

The basic E design permits maximum use of standardized parts . . . closer control over materials, processing, inspection and assembly . . . resulting in faster delivery from interchangeable stocked assemblies.



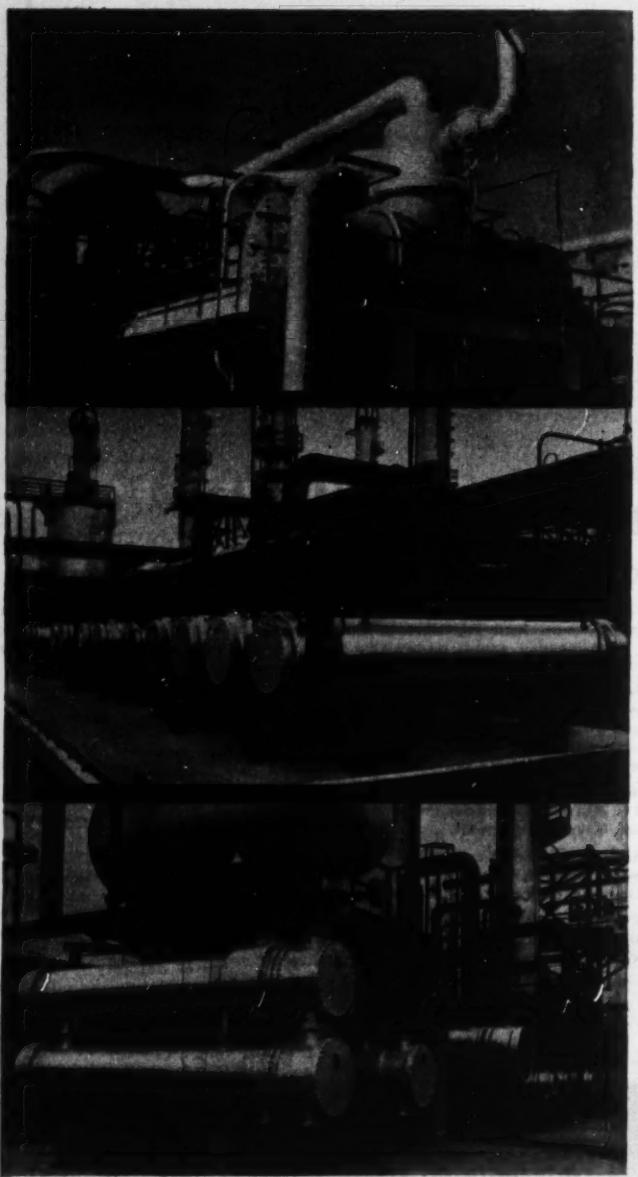
FALK ...a good name in industry

THE FALK CORPORATION, 3001 W. Canal St., Milwaukee 8, Wis.

this...

ROSS

on your specially engineered exchanger means BONUS VALUES



Specially engineered exchangers designed and built by Kewanee-Ross embody features and services that have long been acclaimed throughout the refinery and petrochemical industries. "Bonus values" . . . they're called.

Characteristic Kewanee-Ross standardization is one of them. Substantial delivery time and savings in engineering costs can often be gained through the suitability of standard components for many specially engineered units.

A large stockpile of engineering experience is another. Kewanee-Ross engineers have had long experience with many special and unusual applications. Designing and production are off to a faster start.

Long a leader in the heat exchanger and surface condenser fields, Kewanee-Ross is today in the best position of its history to meet your requirements. Now, with the added capacity of a second large plant (Kewanee, Ill.), recently re-equipped with completely modern machinery and supervised by key "Ross trained personnel," Kewanee-Ross is ideally situated to supply all types of heat exchangers, built to any code, on a very favorable delivery schedule.

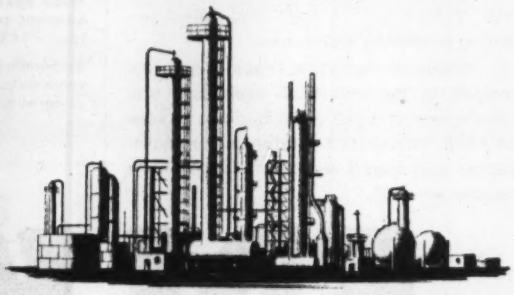
Arrange an immediate consultation with the Kewanee-Ross representative nearest you, at your earliest convenience. You have only your time to invest.

KEWANEE-ROSS CORPORATION

DIVISION OF AMERICAN RADIATOR & STANDARD SANITARY CORPORATION

1448 WEST AVENUE • BUFFALO 13, N. Y.

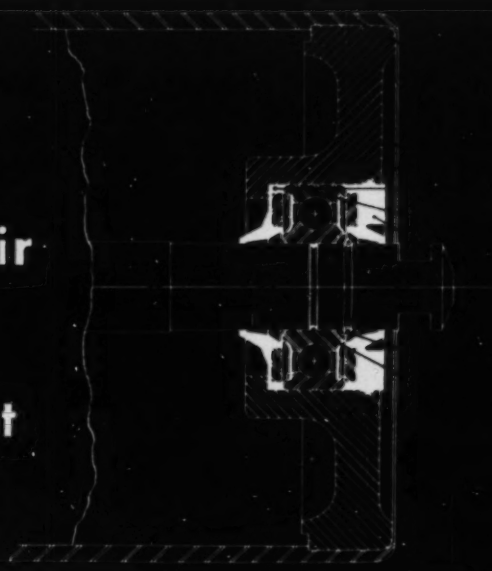
In Canada: Kewanee-Ross of Canada Limited, Toronto 5, Ont.

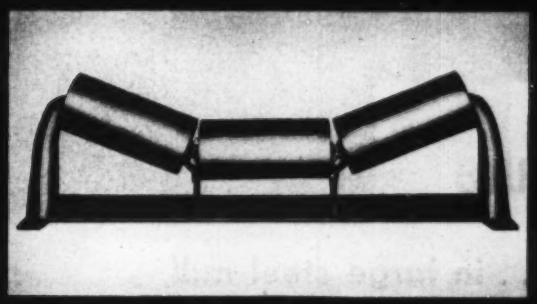


Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS

Trouble Fixed Fast...

by Transall-Fafnir Idler Roll Development





The all steel, jig welded frame of this troughing idler insures roll alignment and facilitates belt training. Each idler roll is equipped with two Fafnir Plya Seal Bearings.

Fafnir-equipped Transall Conveyor for Mine Run Coal. In daily operation since December 1949 . . . 2600 bearings without a bearing failure to date.

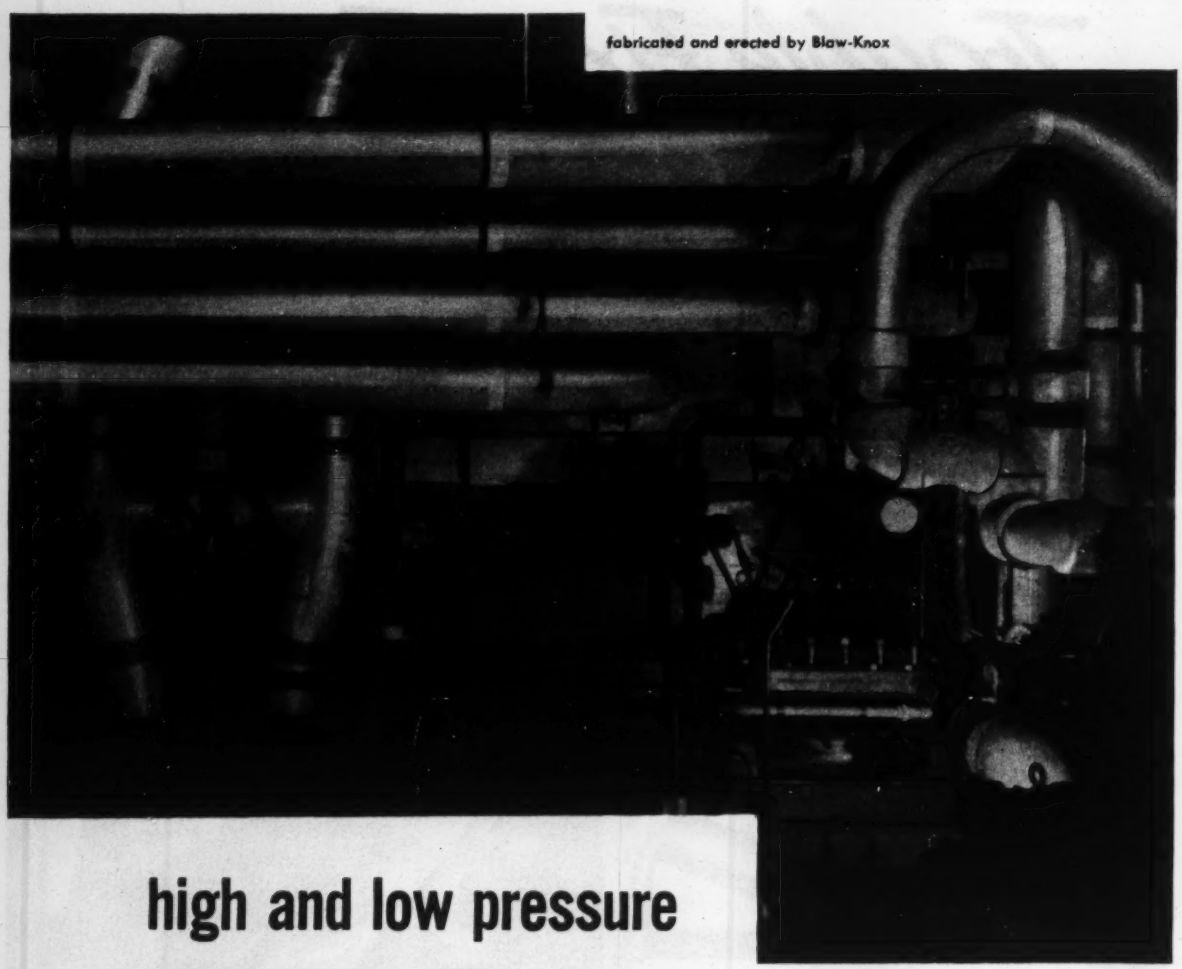
Things began to happen when Transall Designers asked Fafnir Engineers to join them in solving a troublesome conveyor problem. By pooling their experience, the answer was found quickly and simply . . . an improved idler roll with advantages beyond anything available.

Right from the start, the problem was simplified by centering development around Fafnir Plya-Seal Ball Bearings. Factory lubricated and sealed for operation between −60°F. and +200°F, Fafnir Plya-Seal Bearings never need relubrication. The seals are unaffected by moisture and many other contaminants.

Extra insurance against abnormally severe conditions was provided by chrome plating the bearing inner ring to prevent corrosion and abrasion at the point of seal . . . and by the addition of supplementary, resilient bearing closures.

It's another example of the Fafnir "attitude and aptitude" . . . a way of looking at bearing problems from the designer's viewpoint and the ability to supply the right bearing for the need. If you have a bearing problem, why let it drag. Bring it to Fafnir like most people do. Maybe your trouble can be fixed fast. The Fafnir Bearing Company, New Britain, Conn.

FAFNIR
BALL BEARINGS
MOST COMPLETE LINE IN AMERICA



fabricated and erected by Blaw-Knox

high and low pressure boiler feed piping . . . in large steel mill

To get more information on piping for industry write for your copy of Bulletin No. 2443.

When you need a piping system similar to this one . . . or a system for any pressure and any temperature requirements . . . you can readily obtain the benefit of our long experience in this field. We'll take the job from original engineering to final erection. Always in close cooperation, of course, with your consultants or your own organization.

This complete service includes modern shop facilities for hot and cold bending, welding and fabricating all types of piping. A metallurgical research laboratory which assures you of the latest developments in high pressure, high temperature piping. Newest types of testing equipment to assure the soundness and strength of the piping.

And a complete service force equipped with modern machinery for field erection . . . plus the necessary manpower to handle jobs of any size.

How much service do you want?

We can readily (1) engineer, fabricate and erect your job . . . or (2) simply fabricate and erect . . . or (3) fabricate only.

Our engineers will quote from your drawings . . . or, when desired, make a field study of your piping requirements before quoting.

Let us know your service requirements . . . and we'll provide what you need.

BLAW-KNOX COMPANY
Power Piping and Sprinkler Division
Pittsburgh 33, Pennsylvania

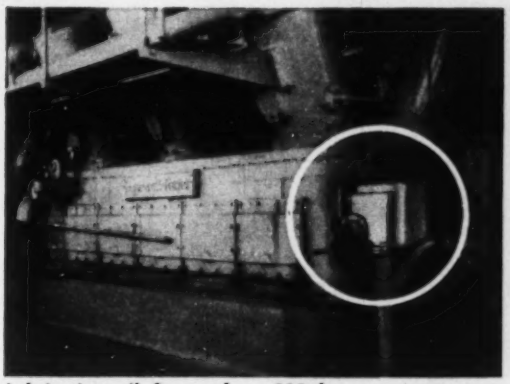
BLAW-KNOX

POWER PIPING

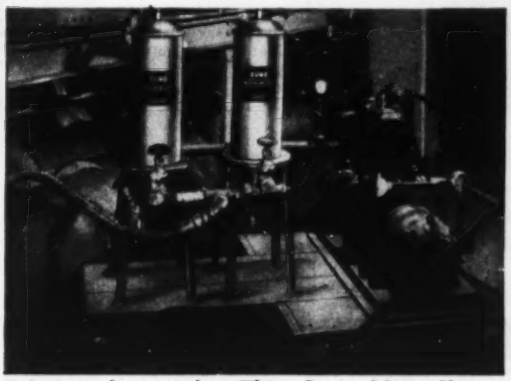
Complete prefabricated power piping systems for all pressures and temperatures . . . plus complete line of functional spring hangers • rigid hanger assemblies • overhead roller assemblies • supports • vibration eliminators

See how Cuno handles any filtration problem

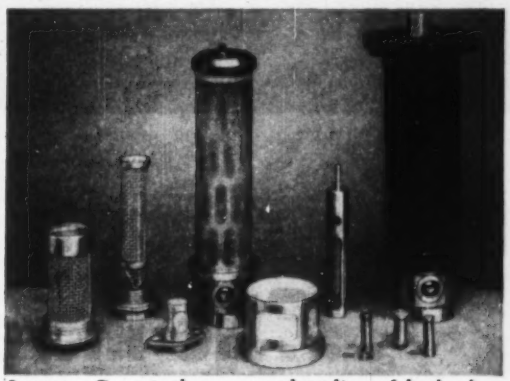
10,000 gallons of water per minute are filtered by six of these Cuno FLO-KLEAN filters, used to remove sand and gravel from incoming well water at pharmaceutical plant. Plant records show that the FLO-KLEANS, by protecting valves and pumps from wear caused by sand, are responsible for saving up to $2000 per month in maintenance costs.



Lubricating oil for modern 600 hp gas compressor is thoroughly strained by four Cuno AUTO-KLEAN filters. The continuously cleanable all-metal AUTO-KLEANS are specified as standard equipment by leading manufacturers of Diesel engines, compressors, pumps, machine tools and other heavy-duty machinery.



Paints and enamels. This Cuno MICRO-KLEAN installation filters enamel being pumped from storage tanks to shipping containers. This micronic media provides finer filtration at lower costs for chemicals, oils, gases, water and many other liquids. Records show that the MICRO-KLEAN element lasts twice as long as ordinary cartridges.



Screens. Cuno makes a complete line of both electrolytically formed and woven screen strainers designed to be built into your product. The electrolytically formed screens are available in nickel; the woven screens of steel, brass, copper, stainless and other alloys are provided in all standard variations of weave.

• We're really proud of our growing list of satisfied customers, like Buda, Bullard, Consolidated Paper, Du Pont, Ingersoll-Rand, Pratt & Whitney, Sherwin-Williams and others who use Cuno filters for anything from acids to tar. They know that if it can be pumped, Cuno can filter it.

We'd like to know about your filtration problem, too. Write for free analysis questionnaire. Cuno Engineering Corporation, Dept. 654, Meriden, Conn.

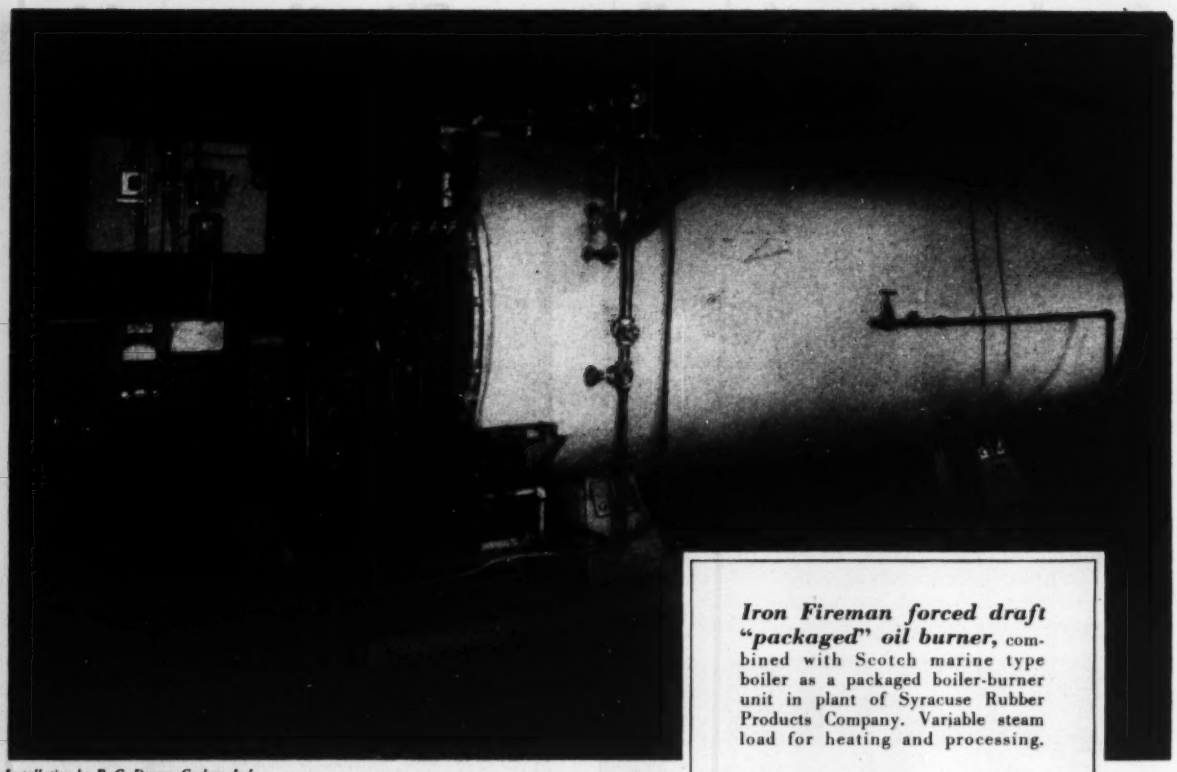
3.4

CUNO

ENGINEERED FILTRATION

Removes More Sizes of Solids From More Kinds of Fluids

AUTO-KLEAN (disc-type) • MICRO-KLEAN (fibre cartridge) • FLO-KLEAN (wire-wound)



Iron Fireman forced draft "packaged" oil burner, combined with Scotch marine type boiler as a packaged boiler-burner unit in plant of Syracuse Rubber Products Company. Variable steam load for heating and processing.

Installation by R. C. Dreves, Goshen, Ind

Boiler capacity doubled . . . no increase in fuel cost

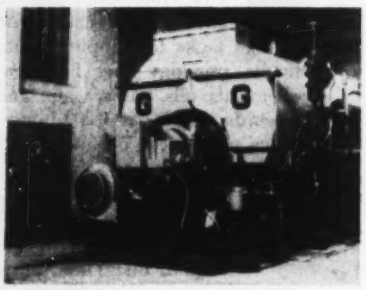
That's the experience of Syracuse Rubber Products Co., Inc., Syracuse, Indiana, with IRON FIREMAN packaged oil burner

This new steam plant, with complete oil firing system by Iron Fireman, carries twice the load of the old one. Steam pressure has been stepped up from 90 to 125 psi. In spite of this doubled output, "the cost is about the same as the previous plant to operate," says Mr. Hubert R. Anglemyer, President. "We also have drier steam in our processing, which cannot be measured in dollars. We have had no down time. Dependability of equipment and ease of operation and maintenance are outstanding."

For further information mail coupon, or call your Iron Fireman dealer.

Iron Fireman advantages

1. Packaged burner unit (for oil, gas or oil-gas combination firing) is assembled and tested at factory instead of on the job. No divided responsibility for burner, electrical wiring, control system, oil heating equipment.
2. Applicable to nearly all types of boilers.
3. Continuous high combustion efficiency.
4. Forced draft. No high stack needed with Scotch or sealed firebox boilers. Requires only vent pipe.
5. For gas or oil, or both. Combination burner shifts fuels at a moment's notice.
6. Burns low cost oils (No. 6 or lighter).



Old steam plant out—new one in—steam up—all within 36 hours. Scotch marine boiler with Iron Fireman packaged oil burner being rolled into the plant of the Meadowsweet Dairy, Tacoma, Wash. This unit was in operation just 36 hours after the crew walked in to dismantle the old boiler—a graphic example of savings in labor and production time. Installation by Lawler Boiler & Heating Co., Tacoma

Iron Fireman.

OIL, GAS OR COAL FIRING FOR HEATING, PROCESSING, POWER

IRON FIREMAN MANUFACTURING CO.
3062 W. 106th Street, Cleveland 11, Ohio

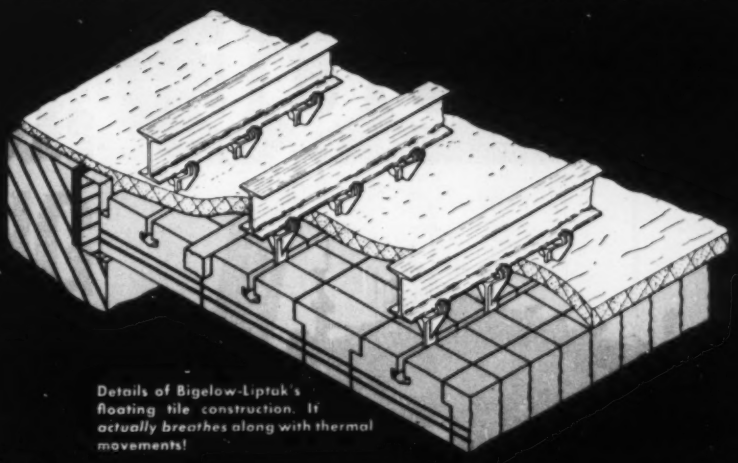
Please send detailed information on Iron Fireman packaged burner units for oil, gas, and oil-gas combination firing.

Name_____

Address_____

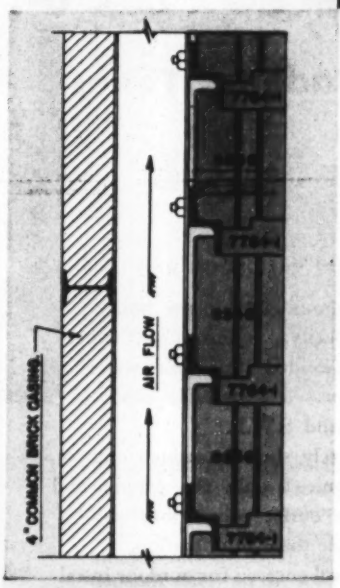
City_____ State_____

Suburban Detroit's New Incinerator . . . .



Details of Bigelow-Liptak's floating tile construction. It *actually breathes* along with thermal movements!

WILL BE TOUGHER THAN BLAZES!



Cross section of B-L's arch construction. Note how heavy, heat-resisting castings support the tile.

City planning engineers and consultants will be vitally interested in the fact that Bigelow-Liptak's unique, unit-suspended design for furnace walls and arches makes incinerators "tougher than blazes" too.

Proof of that fact lies in the many B-L installations which dot the country. Right now, in suburban Detroit, Michigan, construction is underway on a large incinerator which features the B-L design.

In a nutshell, unit-suspended construction provides longer, trouble-free life at a lower, overall cost.

Here's why:

1. Each tile is individually supported—there's no "stacked up" burden caused by the ones above it. Thermal expansion is confined to individual tile. Mechanical spalling caused by pinching, buckling, etc. is eliminated. That adds up to no cumulative loading or expansion.
2. If repairs ever become necessary, any small section of tile can be removed and replaced without disturbing adjacent areas. This cuts the size of the repair job as all other areas—above, below, at the sides—need not be touched.

Remember: you'll pay less in the long run. Countless installations in boiler houses, oil refineries, metallurgical furnaces—wherever heat must be controlled—have proven that fact. Write for information—today.

BIGELOW-LIPTAK *Corporation*

and Bigelow-Liptak Export Corporation

2550 W. GRAND BLVD. • DETROIT 8, MICHIGAN

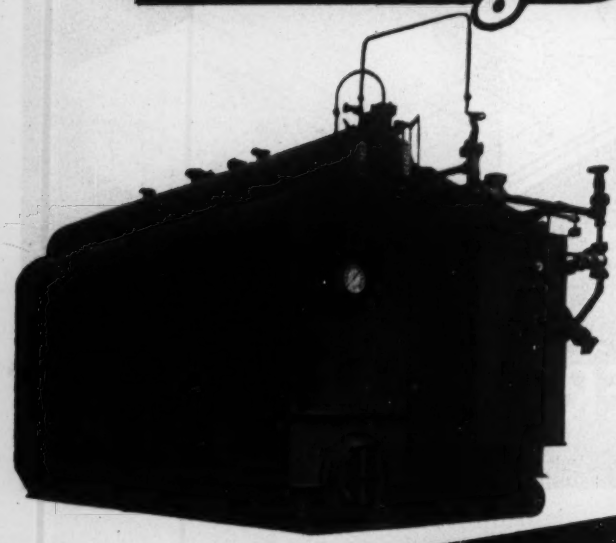
UNIT-SUSPENDED WALLS AND ARCHES

In Canada: Bigelow-Liptak of Canada, Ltd., *Toronto, Ontario*

ATLANTA • BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND • DENVER • HOUSTON • KANSAS CITY, MO. • LOS ANGELES • MINNEAPOLIS • NEW YORK PITTSBURGH • PORTLAND, ORE. • ST. LOUIS • ST. PAUL • SALT LAKE CITY • SAN FRANCISCO • SAULT STE. MARIE, MICH. • SEATTLE • TULSA • VANCOUVER, B.C.

Vogt

Gas Fired
PACKAGE UNIT
Steam Generators
selected by
PHILLIPS CHEMICAL CO.
Pasadena, Texas Plant



TOP: One of the completed units prior to shipment.

BOTTOM: Shop erection view shows tile and block insulation in convection wall; also main baffle tile and furnace floor tile.

Principal Data, Each Unit

25,000 pounds steam per hour capacity. Induced draft type.
Fusion welded steam and water drums designed for 425 pound S.W.P.
Completely shop assembled and required only the piping and gas outlet connections to place them in operation.
Fully steel encased for outdoor installation on a simple foundation.

•

**Vogt Steam Generators are available in bent tube types and straight tube forged sectional header types for solid, liquid or gaseous fuels. Bulletins on request.*

HENRY VOGT MACHINE CO.
Louisville, Kentucky

BRANCH OFFICES: New York, Philadelphia, Chicago, Cleveland, St. Louis, Dallas, Charleston, W. Va.

TURQUOISE GRADING *is tried and true!*

A test pencil is first weighted to average drawing pressure and inserted in this exclusive Eagle Shading Machine. The machine then moves a sheet of paper back and forth beneath the point. Because all other factors are equal, the blackness of the shading depends solely on the trueness of the pencil grade.

The chart prepared by the Shading Machine is then placed under the electric eye of this Reflectometer calibrated to black and white glass standards. The sensitive dial indicates the blackness of the shading to a fraction of one percent . . . and *proves* the test pencil true to grade!

Because each of the 17 TURQUOISE grades is made from a separate formula . . . and because each grade is both *tried* and *true* . . . TURQUOISE will give you exactly the line you want every time!

PROVE IT YOURSELF. Write us for a sample of the new TURQUOISE in any degree you desire. Please name this publication.

EAGLE *"Chemi-Sealed" (Super Bonded) *TURQUOISE *Drawing Pencils & Leads*
With 100% *"Electronic" Graphite

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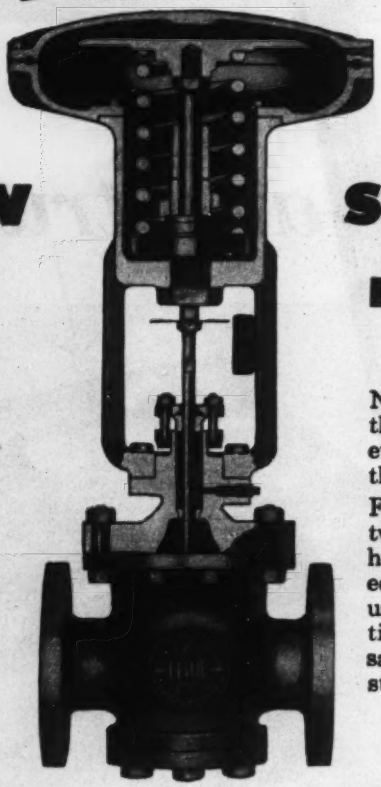
something **SPECIAL** in a **STANDARD** control valve...

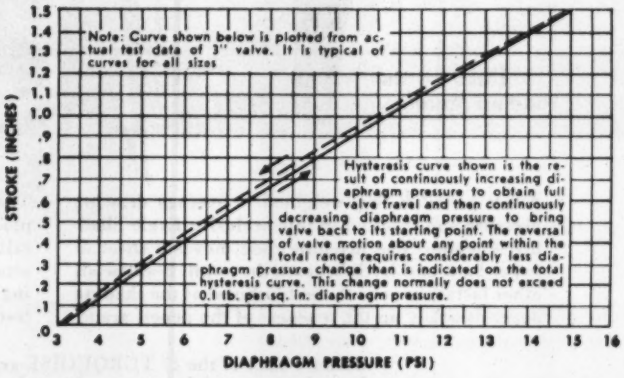


NEW SUPERSTRUCTURE

FOR LESLIE DIAPHRAGM CONTROL VALVES

Now standard for *all* Leslie Diaphragm Control Valves, this new rugged, precision stroke, superstructure means even more reliable performance than the high level set in the past by Leslie.

For instance, linearity (the straight line relationship between diaphragm pressure and inner valve movement) is held to plus or minus 2% for valve strokes up to 1½"—equivalent to .020" for valves with 1" stroke without using valve positioner. Hysteresis, the difference in position of the inner valve on the up and down strokes for the same diaphragm pressure, is held to 2% of full valve stroke for travel up to 1½". Here is the curve.


Note: Curve shown below is plotted from actual test data of 3" valve. It is typical of curves for all sizes
Hysteresis curve shown is the result of continuously increasing diaphragm pressure to obtain full valve travel and then continuously decreasing diaphragm pressure to bring valve back to its starting point. The reversal of valve motion about any point within the total range requires considerably less diaphragm pressure change than is indicated on the total hysteresis curve. This change normally does not exceed 0.1 lb. per sq. in. diaphragm pressure.
STROKE (INCHES)
1.5 1.4 1.3 1.2 1.1 1.0 .9 .8 .7 .6 .5 .4 .3 .2 .1 .0
3 4 5 6 7 8 9 10 11 12 13 14 15 16
DIAPHRAGM PRESSURE (PSI)

Only Leslie gives you all of these "made-to-order" advantages in a standard valve.

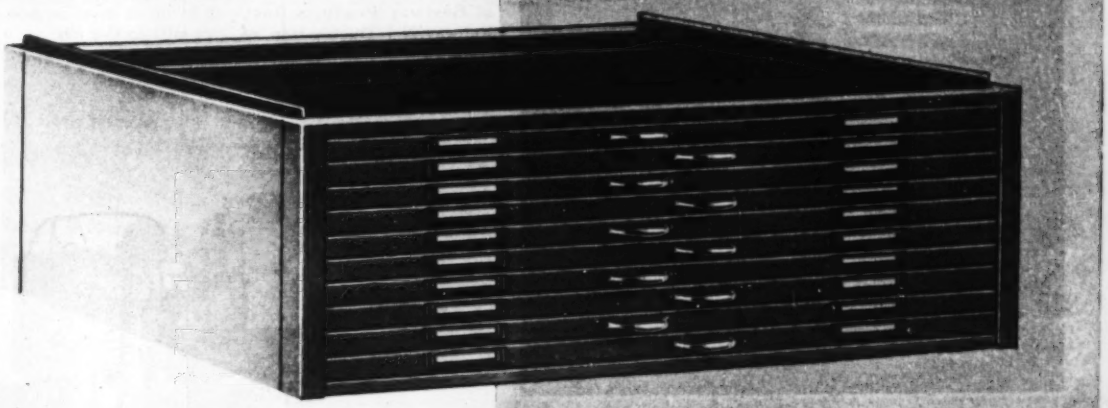
- ✔ Full-flow, smoothly contoured body
- ✔ Renewable, interchangeable seat rings
- ✔ Bolted stuffing box
- ✔ Molded rings or Teflon packing
- ✔ Thermo-isolating bonnet
- ✔ Accurate part replacement from name plate data
- ✔ Stem flats for ease of connection

Send for
Bulletin 5304 (Single Seated Diaphragm Control Valves)
Bulletin 5305 (Double Seated Diaphragm Control Valves)

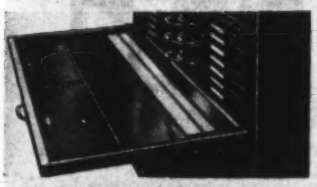
TRADE LESLIE MARK
REGULATORS SINCE 1900
STILL FAR AHEAD IN QUALITY AND PERFORMANCE

LESLIE CO., 287 Grant Avenue, Lyndhurst, New Jersey

Keep more tracings safer...handier

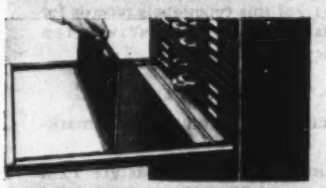


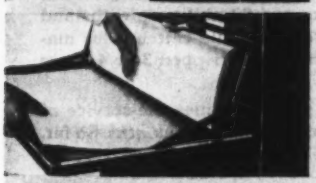
in Hamilton Shallow Drawer Units



KEEPS THEM FLAT

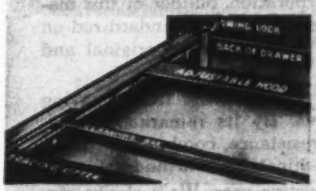
Each drawer equipped with exclusive Tracing Lifter, which also acts as compressor to hold sheets down flat—preventing crumpling, curling, or tearing.





INSTANT SELECTION

Front half of Tracing Lifter raises to let sheets be folded over and back, until desired drawing is found and easily slipped out, other sheets remaining in place.



FITS MANY SIZES

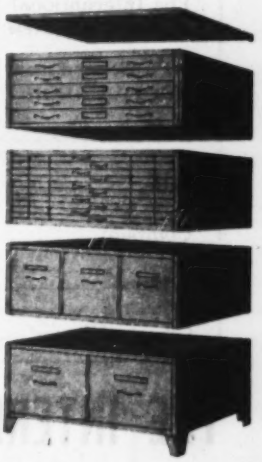
Conforming to various tracing sizes, adjustable rear hood slides over slotted drawer sides to required depth. Swing bar drops to secure hood—keep sheets from creeping over back of drawer.

There's so much less wear and tear—and *no loss*—when your tracings are kept smooth and flat in Hamilton's popular Shallow Drawer Unit. This 10-drawer unit, only 15⅜" high, holds up to 1,000 drawings safe within its rugged walls of heavy spot-welded steel—yet lets you find any *one* of them instantly!

Hamilton builds outstanding units for every tracing storage need, many units interlocking into one installation—*all* of them likely to save you much money in irreplaceable work and time. Why not contact your Hamilton dealer soon?

SAVES FLOOR SPACE

Many Hamilton Units (Shallow Drawer, 5-Drawer, Vertical Units) interlock into single, compact UnitSystem to build storage facilities upward. Interlocking caps and bases available.

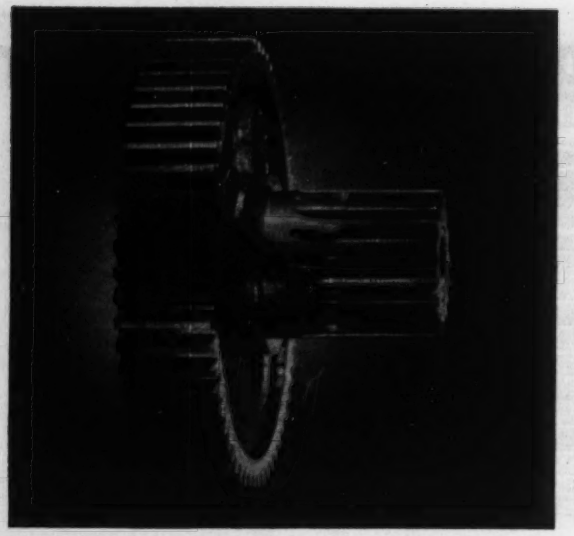


DRAFTING EQUIPMENT DIVISION

Hamilton

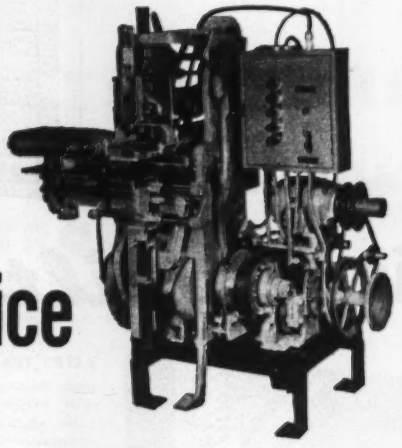
MANUFACTURING COMPANY

Two Rivers, Wisconsin



Fit as a fiddle . . . aptly describes this Ductile Iron camshaft drive gear. It was installed in an automatic labeling machine on March 3, 1952, at Bestway Products, Inc., Rahway, N.J. Ductile Iron "as cast" provides high strength, resistance to wear and galling, with good notched endurance properties. Inspection of the gear on June 15, 1953, found it to be as good as new and it's still on the job.

12 TIMES Longer Service with Gears of Ductile Iron



Harmony in motion . . . is essential in the musical record business, where downtime of equipment stops deliveries with dire results. Look at this "Pony Label-Dri" automatic labeling machine, produced by New Jersey Machine Corporation, Hoboken, N.J. One of this type labels records for Bestway Products, often 'round the clock.

"You can't sell Christmas records in January."

That's the way Louis Quitoni, Plant Superintendent, of Bestway Products, Inc., put the problem when his labeling machine – geared for 1,000,000 records a month – kept breaking down.

Imagine the backlog that built up, and what happened to deliveries . . .

Until this Ductile Iron gear was installed.

"The latest gear . . . machined from a Ductile Iron casting," writes Bestway Products, "has given a truly remarkable performance."

* * *

The two principal requirements of this gear are 1) a high order of wear resistance and 2) ability to withstand sudden shock loads imposed by a knife clutch. This machine is intermittently operated and tripped 3 or 4 times a minute.

So far, Ductile Iron has given 12 times the service of high test iron gears which failed in about 2 *months*. So far, the initial Ductile Iron replacement has served 2 *years*, and it's still on the job.

New Jersey Machine Corporation, builder of this machine, as a result of this service life has standardized on Ductile Iron for camshaft drive gears for original and replacement installation.

In plants from coast to coast, Ductile Iron is saving money at every turn. How? By its remarkable load-carrying ability and wear resistance, combined with excellent castability, ready machinability and moderate cost.

Send us details of prospective uses. We'll gladly suggest a source of supply from some 100 authorized foundries now producing Ductile Iron under patent licenses. Request a list of available publications on Ductile Iron . . . mail the coupon now.

The International Nickel Company, Inc.
67 Wall Street, New York 5, N. Y.

Please send me a list of publications on DUCTILE IRON.

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MECHANICAL ENGINEERING

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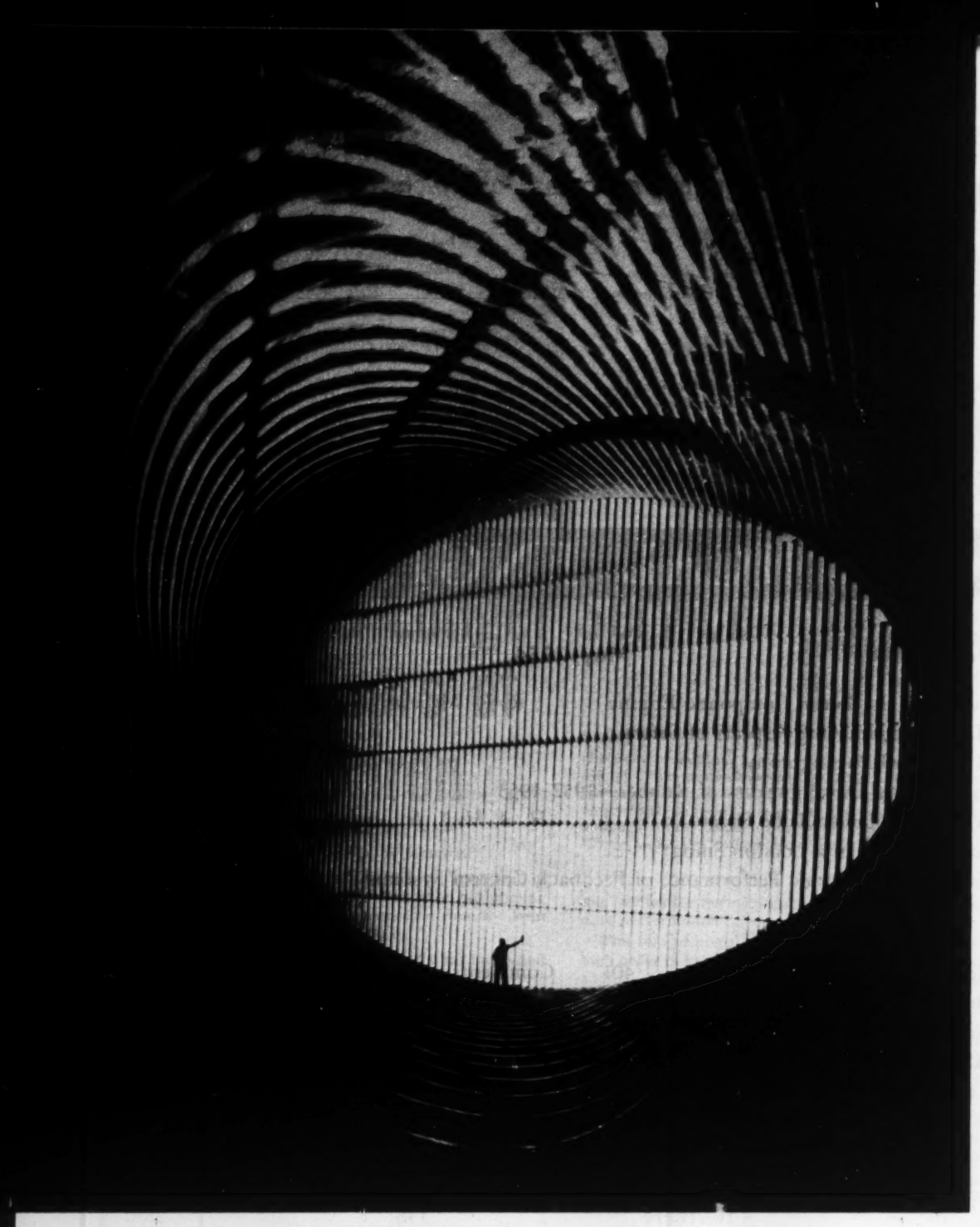

Interior view of NACA transonic wind tunnel...

... at Langley Aeronautical Laboratory, Langley, Va. For a comprehensive look at the wind-tunnel industry in the United States, private and government, see pp. 434 to 436 in this issue.

Editorial

MECHANICAL ENGINEERING

May, 1954, Vol. 76, No. 5 . George A. Stetson, *Editor*

How ASME Does Its Work

EARLY EACH year, as soon as possible after appointments for the administrative year have been made, The American Society of Mechanical Engineers issues Manual AC-10, "Personnel of Council, Boards, and Committees." This impressive and useful document is a part of the ASME Society Records section of the Transactions and is bound with every annual volume. Hence it serves as a working document for the current year and as an historical record for future reference. As the years go on, the number of committees and committeemen continue to grow and to reflect the growth of engineering.

No one can glance over this 64-page list of officers, Board members, committeemen, regional, section, and student-branch organizations, professional-division, standards, and codes personnel, ASME representatives on joint bodies, past officers, honorary members, and recipients of medals and awards, without being impressed with the large number of loyal and influential persons who are giving, or have given, loyal service to the Society and without a feeling of amazement at the broad extent of the Society's technical activities. Merely scanning the manual should generate a feeling of pride in being a member of such an organization. Should a member find his own name among the hundreds of others, he may justly entertain a sense of satisfaction that he, through his Society, is doing his part in forwarding the advancement of the engineering profession for the benefit of his fellow engineers. In this manual, year after year, is found testimony that none of the Society's, activities could be carried on and none of the benefits which accrue to engineering and to the nation as a result of these activities would be possible if it were not for hundreds of devoted men, whose individual and collective talents are made effective through the Society, at what cost in terms of time, energy, and money no one can fully estimate. In the next few decades influences which magnify the importance of engineering in the advancement of civilization will demand even more ASME activities and even wiser and more able men than have served it in the past.

ASME Objectives

Pondering the general objectives of ASME set forth in the Constitution, the means mentioned in the By-Laws by which they should be accomplished, and the great variety and breadth of activities represented by the committees and committeemen currently at work, one comes to think of the Society as an institution dedicated to the advancement of knowledge. Although the educational programs of the Society differ in many particulars from the formal courses of study and curricula of universities, the broad objectives are much the same—accumulation and dissemination of knowledge and the training of men to study, acquire, and utilize that knowledge for the benefit of themselves and their fellows; the training of good citizens well adjusted to the times and to their environment; and the awakening in them of a recognition of the satisfactions which life holds for them and a desire to strive for the attainment of those satisfactions. For education, which begins with childhood in the home, the church, and the school, continues throughout the remainder of a man's life, under less formal conditions, where voluntary service, self-discipline, and self-interest are substituted for authority imposed by parent, teacher, and the community. Through its committees, meetings, and publications ASME performs its functions as an educational institution and aims to provide its members with the means whereby they may continue to grow in knowledge and usefulness throughout their lives. Where the university ceases to serve the individual directly, the engineering society must take up the burden.

The Search for Truth

Individual survival and growth, and the progress of civilization itself, depend on man's ever-increasing ability to learn. The more complicated and competitive life becomes, the more essential is the need to expand knowledge. Modern society, particularly in the western world, has taken great strides toward improvement of material welfare, the conquest of disease, the abundance and quality of food supply, the adequacy and comfort of shelter, the ease and rapidity of communications and transportation, and the variety and volume of productivity in terms of goods, services, and the amenities of life.

It is the search for truth and the application of the knowledge gained in that process which animates the programs of activities of learned societies like ASME. Research, the holding of meetings, the publication of technical papers, the standardization and codification of engineering practice are basic to these activities. To originate and carry out these activities demands educated and dedicated men and progressive organizations through which their combined knowledge and energies may be brought to bear on the task of maintaining what prog-

ress has been made in the past and expanding that progress on all fronts toward the greater knowledge of the truth that will make the future more secure. Neither with individuals nor with society and nations can the search for truth be halted, or the movement of progress become static. If men and nations do not advance, they halt and eventually retrogress. The seed corn of the past must be made to grow. Otherwise it is wasted and lost. ASME has never lacked men who cherish its heritage and add to it year by year.

Greater Fields for Engineering

It is only natural that engineers should recognize and desire to expand truth as it is revealed to them in the material world—the world of the physical sciences and of applied science. Their roots are firmly bedded in the mechanic arts, in an agelong familiarity with materials as they appear in nature, in the simple laws of mechanics illustrated in almost every commonplace object and experience of daily life, in the dynamics of wind, wave, and everyday motions, and in the mysteries of fire, heat, and extreme cold and their effects. Long before men knew *why*, they could predict *what* might happen. They knew the penalties of disobeying nature's laws long before they understood the laws themselves. "Why" was answered by science. From the orbits of the planets have been developed laws which govern the motions of terrestrial bodies. And by processes of pure reason came mathematics, language, and tool of science, "number, queen of all the arts." Science and the mechanic arts are merged in the work of the engineer.

And if knowledge is so necessary in the material world—in the physical sciences and engineering—is it not necessary in other areas also, if men can develop the skills to discover it? Who could have predicted, a century ago, how vastly the biological sciences would have developed in so short a space of time? In the arts, in aesthetics, in the relationships of a man with his fellowmen, in all that vast region of men's desires and strivings which seems remote and detached from the physical and material world, may there not exist a body of knowledge and a number of laws or essential truths awaiting discovery? If they are obscure and attainable only through speculation and faith today, may they not, in future, have substance and attain acceptance?

Science and engineering, preoccupied with fields of knowledge more easily explored and developed, will not turn their backs on these other areas. Although at times it seems as though science may have uncovered knowledge that threatens to destroy man, will not the way be found to avoid disaster and open new avenues for human progress?

In the western world, where spectacular advances in the conquest of hunger, disease, and safeguards against the rigors of physical environment have been made, an ever-increasing number of persons are being released from the task of producing the bare material necessities of existence. With time, incentive, and education this growing number of educated persons will not be satisfied with the fruits of idle leisure and will turn their talents toward the exploration of fields of knowledge where these nonmaterial relationships are eventually to be found.

Engineers have played an important role in developing conditions favorable to a widespread search for knowledge of how man may live in peace and security in an age of rapidly expanding physical science. Indeed, they are already at work on this problem in the management of industrial enterprises where the peace and secuity of large groups of people are involved. Who can say but what success in the improvement of human relationships in industry may point the way in community, national, and international relationships?

During the next few decades engineers will be working even more purposefully than they have in the past toward the attainment of a better way of life for their fellowmen. One may hope that these decades will witness further progress of the great emancipation of the human race—the elimination of slavery of all kinds, of ignorance, suspicion, fear, political oppression, hunger, want, disease of mind and body, and at least the more tragic of human follies. During those decades, engineers will continue to increase knowledge and improve the techniques of their profession that have been so effective in the past. They will be forced to follow closely the discoveries of science and to comprehend the influences of science on engineering and society. As young men they will have to acquire a more rigorous and a broader formal education and continue their studies in postcollegiate life more intensely and seriously. They will bring more effective and more profound thinking to bear on the problem of production and distribution of goods and services. They will increase the amount of power available for doing the work of the world and for decreasing the burdens of human toil. They will advance as leaders of industrial enterprises. They will have a more rational understanding of the influences of engineering on society and human welfare and will develop powers of directing and controlling those influences. And as the work and the methods of engineering spread throughout the world and the great emancipation becomes possible in what are today "backward countries," tensions and insecurity will lessen, and people will be free to develop ways of life that will bring satisfaction and peace among them.

The present is no time to become disheartened about the future. Never before have men had so much to encourage them and to spur them toward better ways of life. Truth is making them free, and the search for truth continues to provide meaning and satisfaction alike. Centuries ago the Greeks extolled the trinity of the good, the true, and the beautiful. In the pursuit of these ideals they found meaning and satisfaction. Although they were enslaved by material conditions under which few of us could survive, they found time to practice the arts, to seek out truth, and to cultivate goodness. Perhaps they sensed that these three ideals had a unity in their dependence on universal laws—laws which, while they may not be known, are none the less knowable. The task of the future is to discover more of those laws, so that men may learn to live in conformity with them. To bear their share of this task will be the lot of ASME members of the future.

Douglas DC-7, world's fastest piston-powered commercial airliner, is powered by Wright R-3350 Turbo Compound engines, each delivering 3250 take-off horsepower. Cruising speed is 365 mph and top speed is 410 mph.

The Future of the Turbo Compound Engine

Now in commercial and large-scale military operation, continued development of the Turbo Compound engine could provide the airlines with economical and reliable transports exceeding 400 mph

By Russel R. Mock[1] and Norton B. Jamieson[2]

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THE relative merits of turbojet versus turboprop versus piston engines as applied to air transports is a question that has been pondered for many years. Fig. 1 is a curve showing the trend of what industry forecasters have been predicting as to the approximate date that scheduled U. S. turbine-transport operation may begin. Some forecasts may have been missed and some slightly misinterpreted, but the general-trend curve is believed to be fairly valid.

As shown by the crosshatched areas, there have been four active forecasting periods since the end of World War II: The first, right after the war; the second, around 1948–1949; the third, in 1952, when the Comet started scheduled operation; and the fourth, in 1953, probably stimulated by active airline study of specific turbine-transport proposals.

As the curve shows, in 1945 it was thought that U. S. turbine-transport operation might start in about 1950. Latest predictions now indicate that it may not start before 1959 or 1960. The trend of predictions, however, is more consistent. The first three points form a reasonable looking trend toward a vertical line which is what should happen as predictions become more accurate. In 1953, however, presumably as the result of reaction to closer studies, an adjustment to this trend appeared. The turbojet prediction was moved ahead one to two years, and a differentiation between jets and props, which began in 1952, became more pronounced. This moved turboprop predictions two to three years farther into the future.

Extrapolating the area contours of these trends (considering the adjustments) to where they become straight vertical lines, a time range of presumably accurate prediction is formed. On this basis, the ultimate predicted date for the beginning of U. S. turbine-transport passenger operation will fall into the following periods: Turbojet Transport, 1958–1962; Turboprop Transport, 1960–1964.

These are broad predictions, and more specific dates would certainly be desirable. Some current developments would tend to indicate that initial operation, in limited form at least, might begin early in the prediction bracket. Hasty conclusions are not warranted, however,

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in view of many important factors that could lead toward a more conservative prediction. Some of these factors will be briefly discussed; and to obtain some helpful background and perspective, past accomplishments in developing U. S. commercial engines and transports will be reviewed.

Piston-Engine Overhaul-Development History

Fig. 2 presents the trend of time-between-overhaul development of Wright Cyclone commercial engines from 1937, when the G-100 and R-2600 were first delivered, to the present. The initial delivery date is indicated under each engine-model designation.

This curve shows that although piston engines have become larger, more powerful, and more complex, the overhaul-period acceleration rates have markedly progressed, and, in general, starting and maximum values have also increased. Whereas the C18BD engine attained 1000 hr in a matter of three years from initial delivery and is currently authorized for up to 1900 hr, the G-200 took $8^1/_2$ years to reach 1000 hr. Within the time range of the chart, the earlier engines never did reach this status. The Turbo Compound engine is initially authorized for 1000 hr following two sets of three overhauls at 800 and 900 hr, respectively. It has a total accumulated experience approaching 1,000,000 engine-hours and has been in commercial service since June, 1953.

The progressive piston-engine improvement shown in Fig. 2 over the years is attributed logically to (1) the accumulated experience in designing and developing this type of engine for airline use, (2) the commendable progress made by the airlines themselves in handling the operation and maintenance of these engines, and (3) the accelerated development progress made during World War II.

In regard to turbine-transport engines, some of this experience may still apply, and certainly the military turbine-engine experience is significant. However, taking a purely objective viewpoint, the following facts cannot be overlooked:

1 U. S. airlines have had no direct experience in operating and maintaining turbine engines.

2 Military experience is largely limited, at least at present, to turbine engines which are relatively simpler and smaller than the majority of those currently contemplated for commercial use.

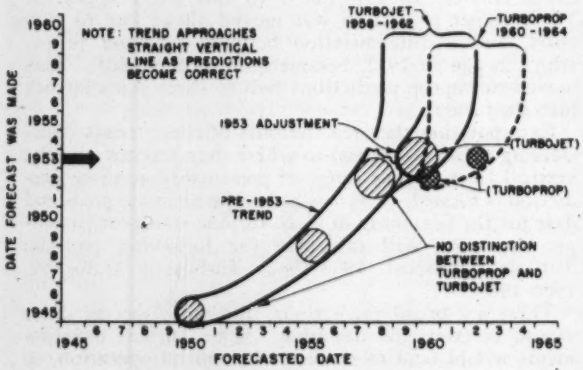

Fig. 1 Trend of predictions on estimated date of initial scheduled operation of U. S. turbine transports

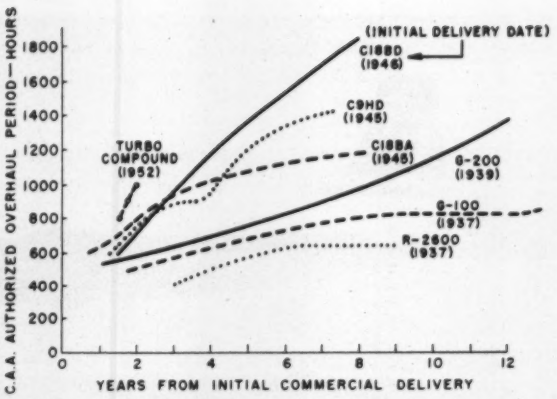

Fig. 2 Time-between-overhaul development history of Wright Cyclone commercial engines

3 Total military turbine-engine operating time, although large, generally is made up of relatively small accumulations on a large number of engines; thus airline required knowledge regarding high time durability and "wear" characteristics is lacking.

4 The expedient of performing pretime "partial" overhauls, as practiced by the military and the British, may be incompatible to U. S. airlines operationally, economically, or mechanically.

In view of the large investment involved in the turbine-transport venture, and the sensitivity of airline economics and efficiency to engine-overhaul period and trouble characteristics, it is a certainty that the airlines are not underestimating the importance of these factors. They will likely be starting out with relatively new, big, complex engines without the benefit of experience on smaller, simpler engines of the same type. Will the initial turbine engines follow the C18BD curve, or the G-200 curve, or will they be superseded by other engines or models before satisfactorily efficient operation is obtained? These are decision-delaying questions in regard to engines that could cause predictions to become more conservative.

Transport Development History

Past accomplishments in developing commercial airplanes are portrayed in Fig. 3. This shows the development history of several commercial transports, from early 2-engine to recent 4-engine, in terms of development years from final go-ahead to first flight, initial certification, and 50th delivery. To avoid war-activity effects, there were not many validly comparable examples, and some adjustments still had to be made. Nevertheless, although perhaps not totally representative, this curve is believed to be sufficiently indicative to draw some general conclusions.

Paramount is the indication that as transports become larger, more complex, and more expensive, the time required for development becomes greater. Development time of the "Recent 2-engine" airplane was about twice that of the "Early 2-engine," and the 4-engine types took more than twice the time required for the 2-engine types.

To extrapolate these data into the realm of the turbine transport, it is possible to choose ratio factors of gross weight, price, complexity, effort, military-application

effect, unknownness, etc., and apply them to the trend. Suprisingly enough, with reasonable variations in these factors—and making the bold and possibly unjustifiable assumption that the noise problem can be solved—the calculated timing for initial U. S. turbine-transport operation will come out generally within the limits of prediction indicated in Fig. 1.

However, there is one important over-all factor that does not show up on the development history chart, but which approaches what is probably the primary crux of the whole situation. This is the question of the money-making ability of the turbine transport, especially the jet.

The examples of Fig. 3 were, of course, restricted to those airplanes which were produced, produced because they were bought, and bought because the buyer was sufficiently convinced that they were money-makers—directly or indirectly, or in one sense or another. Estimating the date of existence of an airplane on the basis of when it could be fabricated or tested, therefore, is not sufficient by itself. It must also sell. The turbine transport may well be a money-maker; but if it is, the airlines are apparently not yet sufficiently convinced of this, and if so, they are unconvinced because of the large number of critical unknowns involved, only some of which have been mentioned herein. Thus, because of these unknowns and the high investment involved, final decision to buy may be considerably delayed.

As we all know, competition from the present and forthcoming British turbine transports is the primary motivating force behind the urgency of U. S. transport development and U. S. airline interest in turbines. Should the pressure of this competition become strong enough, the affected U. S. airlines might be forced prematurely to buy whatever turbine transports are available, be they U. S. or British.

Here again, however, the possibility of this action's taking place depends on many involved and intangible factors which would require comprehensive evaluation. Briefly, these factors are as follows:

1 The competition of British turbine transports will be felt only in relation to the number of them that will be produced and put into direct competitive service with piston transports at any given time. While British production of turbine transports is increasing, that of piston transports, already greater, is also increasing. Moreover, traffic demands have been increasing and are likely to continue this trend. Thus the actual percentage of over-all passenger business that might be lost to British turbine transports during this period of indecision may not be critical.

2 If the economics of turbine transports, existing or in the offing, are at all questionable, the prospects of this being compensated by initially high pay-load factors would be only a temporary remedy. When pay-loads eventually became normal again, the airlines would not want to have a money-loser on their hands. Nor would they desire to charge premium fares on a broad "standard" basis, unless perhaps foreign operators followed suit.

3 Even so, an airline might ordinarily take a chance on an unknown if forced to. However, because of the large investment—much larger than ever before—there will undoubtedly be a strong desire to hold out for a reasonable number of years in order to obtain the best possible airplane.

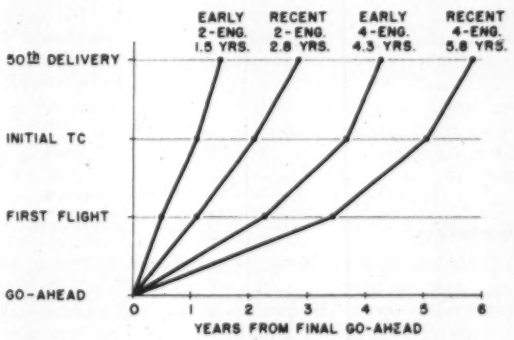

Fig. 3 U. S. commercial transport development history

Therefore, except possibly for those airlines most directly and severely affected by British turbine-transport competition, it is believed that most U. S. operators will elect to stand by as long as possible—until such time as they are convinced that a truly economic turbine transport can be bought, and until such time as they are financially capable of buying it.

These are not all the issues. But these are some of the important ones which would lead to the belief that the beginning of substantial replacement of piston transports by turbine transports is sufficiently far off to warrant serious consideration of further development of piston engines. And for this reason, it is pertinent to review, in a general way, such development potentials that could form the future of the Turbo Compound engine.

Turbo Compound-Development Potentials

The advent of the Turbo Compound engine, Fig. 4, provided a new field of engine design. Not only was maximum power increased and specific weight decreased, but substantial reductions in specific fuel consumption were realized simultaneously with higher cruise powers. From the standpoints of airline speed, efficiency, and economy, this places this engine in a favorable position to compete with the turbine engine of the near future and makes serious consideration of its further development possibilities worth while.

The basic approach to increased power can be directed in one or a combination of three channels: (1) Provision of more air to the cylinders, since basic engine power is proportional to air flow, (2) improvement of basic engine efficiency, and/or (3) improvement in efficiency of the power-recovery system.

Formerly, the most direct approach taken was to increase the air supply to a basic engine design. That is, either the number of cylinders or the displacement per cylinder was increased. Typifying this development trend was the Wright Whirlwind series of 7 and 9 cyl, with 108 cu in. displacement per cylinder, and the Cyclone series of 7, 9, 14, and 18 cyl having 186 cu in. cylinder displacement—an increase of 70 per cent. To obtain higher powers than the present 18-cyl Turbo Compound, this approach would still be possible by either method. However, little change in altitude or economy characteristics would be realized, and additional cylinders or increased cylinder displacement would require changes to the basic engine and turbine structure.

If it is assumed then, that the number of cylinders and cylinder displacement are to remain fixed, some other

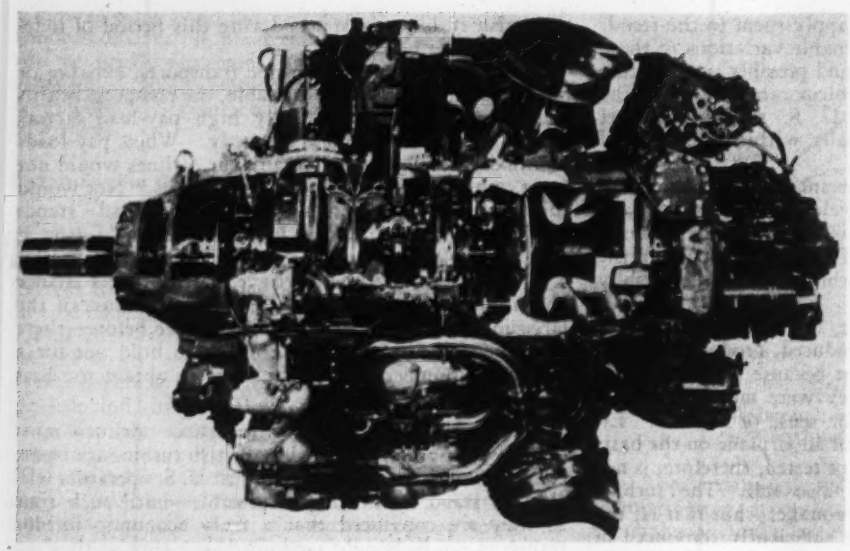

Fig. 4 Cutaway view of 3250-hp 18-cyl, 3-turbine Wright Turbo Compound engine

means of providing more air is required. Cruise powers with a given fuel generally are established on the basis of detonation margin, and present engine ratings are already at the practical maximum for best economy operation. It becomes apparent, therefore, that before increased cruise powers can be realized with the basic engine, the detonation-free range must be extended.

The detonation-free limits in the best-economy range of an engine are largely a function of the air temperature entering the cylinder. In general, a reduction in detonation-limited horsepower of 3 per cent will occur with every 10 deg rise in intake-air temperature. In the past, this effect has many times limited the extent of supercharging because of the inherent increase in air temperature associated with the pressure rise.

Methods of cooling the supercharged air, i.e., intake pipe temperatures, have often been studied but as often dropped because of seemingly unacceptable penalties in engine weight and size. More recent studies have shown, however, that such considerations are practicable, provided the increases in power compensate for the penalties incurred. Adaption of a supercharged air cooler, or "aftercooling" system, to the Turbo Compound engine, could be accomplished with relatively minor changes to the basic engine structure. Such changes would be confined primarily to the supercharger section. Cooling units or sections could be mounted adjacent to the cylinders, on or in an extended supercharger section, or perhaps exist as part of the engine nacelle, with ducting provided between the cooler and the engine. Should this arrangement be feasible, detonation-limited cruising horsepowers could be increased materially.

In addition to raising detonation limits, further benefits of aftercooling would be realized in the form of increased air density. Thus more pounds of air could be "packed" into a given displacement with no increase in supercharged air pressure. This would be especially effective in increasing cruise altitudes as well as cruise powers. Moreover, since power recovery of the Turbo Compound engine is primarily a function of mass gas flow, further increases in recovered power could be anticipated.

Concerning improvements in basic engine efficiency, these are, of course, continually under constant consideration by all aircraft-engine manufacturers. Years of investigation on cams, cam overlap, cylinder porting and valving, compression ratio, spark advance, and basic fuels are in the files. It is safe to assume that current engines reflect the results of this accumulated research and this is particularly true in the case of the Turbo Compound engine.

One of these items, variable-overlap cams, is still worthy of particular consideration. Cam design in respect to overlap between intake and exhaust valve opening is, of necessity, a compromise between the requirements at maximum power and those of cruise power. Variable-overlap cams could provide optimum overlap in each power range. This provision would involve mechanical problems, but would improve engine economy.

Any speculation on the future of the Turbo Compound engine should include methods of improving or augmenting the power-recovery system since utilization of exhaust energy in the current engine still falls short of the actual usable power available.

The design of the current blowdown turbine nozzle was of necessity based on high gas flows, with exit-area reduction minimized to avoid back pressure. This incurred an unavoidable reduction in exit velocity in the cruise range, with a corresponding decrease in power-recovery percentage in this range. This situation could be alleviated by a variable-exit-area nozzle and, coupled with a variable turbine-to-engine drive ratio, could provide a more constant percentage of power recovery throughout the entire power range.

To provide additional power recovery at altitude, a pressure turbine could be combined with the present Turbo Compound engine to effect a double-compounded blowdown and pressure-turbine system. In such a system, the exhaust gas would first "blow down" to approximately sea-level pressure through the blowdown turbine and, when at altitude, the expansion could be completed through the pressure turbine. Theoretically, such a combination would not increase back pressure on the basic engine. The problems incurred during development of such a configuration might be considerable, but the altitude power benefits would be attractive.

Conclusion

These are some of the ways the Turbo Compound engine could be further developed prior to turbine-transport application. The particular method to be pursued depends largely on the timing and performance requirements to be fulfilled.

Human-Engineering Aspects of Safety

By Ross A. McFarland

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Engineering and biological sciences are being integrated in the field of study referred to as "human engineering." A primary objective is to improve safety by designing equipment in terms of human capabilities and limitations—to design machines from the man outward. Thus instruments and controls may be considered as extensions of his nervous system and body appendages.

THE "human-engineering" approach to the solution of the accident problem is to build machines and working areas around the operator, rather than to place him in a setting without regard to his requirements and capacities. Unless this is done, it is hardly fair to attribute so many accidents to human failure as is usually the case.

If this point of view is carried out in practice, fewer accidents should result, training costs should be reduced, and extensive redesign of equipment after it is put into use would be eliminated. In this regard, two publications by the author, although dealing primarily with aircraft, nevertheless have broad implications for the application of human engineering in all fields.[1]

The Role of Accidents

The importance of this problem is evident from the fact that one of the major causes of death and injury in both military and civilian populations relates to accidental injury. The loss of life and incapacity resulting from accidents are as great as or greater than loss and incapacity from any known disease entity. Accidental injury ranks first as the leading cause of death for persons between 1 and 24, and second for those between 25 and 44 years. The fact that these victims are in the younger age groups, in contrast to those whose deaths are attributable to certain degenerative diseases, implies an enormous cost to the productive resources of the country in terms of life-years. Measurement of nothing but the fact that a death has occurred is less meaningful than the measurement of how much lifetime has been lost prematurely. An 80-year-old man dying of heart disease and a 12-year-old boy run over by a car are each counted as one death under the presently used methods.

Designing for Human Capabilities

One of the most important ways of improving safety is to design equipment in terms of human capabilities and limitations. We learned in the Second World War that machines do not fight alone. Radios do not hear; radar doesn't see; sonars don't detect; guns don't point, any more than automobiles drive themselves. Difficulties arise when mechanization becomes too complicated for human operators.[2]

More precisely stated, the engineer must have an understanding of the sense organs and the characteristics of human perception if satisfactory information is to be supplied from sounds and lights in the operation of equipment. In general, man is a poor monitor of equipment. Next, the engineer must not place unreasonable demands upon the operator in regard to the physical responses involved, i.e., in reaching or operating a control or lever or in clearly differentiating between them. Otherwise, an inadvertent operation of a switch or control may occur. Then, the engineer must consider that the operator of equipment is frequently suffering from temporary impairment of functions causing inefficiency such as fatigue, and there may be changes in function as a result of aging. Finally, the physiological and environmental conditions such as temperature, humidity, toxic gases, altitude, and other factors must be considered, or physiological limits may be exceeded.

A good illustration may be drawn from the confusion arising when controls for operating the flaps and landing gear of aircraft are too close together or reversed from one plane to another. Inattentive manipulation or mistaken identity resulted in 457 aircraft accidents in one of the services during a 22-month period, January, 1943, to November, 1944, of which 273 occurred in advanced trainers and 184 in fighters, bombers, and transports. This occurred several times on the airlines and the author is aware of such an accident involving one of the outstanding test pilots of the country.

Prevention of Accidents by Advance Analysis

All possible faults in equipment and in the working area of a plane, truck, or bus, as well as the capacities of the operator, should be subjected to an advance analysis

[1] "Human Factors in Air Transport Design," by R. A. McFarland, McGraw-Hill Book Company, Inc., New York, N. Y., 1946.
"Human Factors in Air Transportation: Occupational Health and Safety" by R. A. McFarland, McGraw-Hill Book Company, Inc., New York, N. Y., 1953.

Contributed by the Safety and Management Divisions and presented at the Annual Meeting, New York, N. Y., November 29–December 4, 1953, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Slightly condensed.

[2] "Machines Cannot Fight Alone," by S. S. Stevens, *American Scientist*, vol. 34 (5), 1946, pp. 389–400.

for preventing accidents. If defects are present, it is only a matter of "time" before some operator "fails" and has an accident.

Advance analysis assumes the following considerations: (1) This involves an operational job analysis that should include a survey of the nature of the task, the work surroundings, the location of controls and instruments, and the way the operator performs his duties. (2) A "functional concept of accidents" is implied, that is, the errors are anticipated that may occur while the operator is working at the machine. The repetition or recurrence of near or real accidents clearly indicates a need for redesigning. (3) This consideration relates to "human limitations." It should be assumed that no driver is a perfect one. In fact, he may be far below the ability adjudged by the designer. If his duties are too complex, the cumulative burden is great and he reaches or exceeds his limits of attention and ability.

Finally, a wide margin of safety should be provided to eliminate any possible situation that places the operator near his maximum ability with regard to aptitude or effort, especially when adverse factors enter the picture.

Operational Job Analysis

One of the first steps in insuring safety on the job is to make an analysis of what is required of the individual and to study the more critical features of each job. Many accident potentials can be revealed by this procedure. Each type of equipment and its operation must be subjected to thorough study and interpretation, in order to understand what is expected of employees. Techniques involving "near accidents" are often revealing and minor incidents should be recorded and interpreted.

A study was made of near accidents during routine bus operations at night and during the day to discover (*a*) the number of variables involved in emergencies, (*b*) how the driver determines the nature of an emergency, (*c*) how the driver reacts to prevent an accident, (*d*) the variety of critical situations and their relative frequency, and (*e*) the relations between near and real accidents.

The study revealed that as a rule critical situations develop very rapidly and are of short duration. Of the 66 near accidents observed, 53 or 80 per cent of them were closely related to the three most common types of accidents which actually occur on the highway, namely, side-swipe, rear-end, and head-on collisions.

The most important variables contributing to the critical situations were as follows: (1) Following too closely; (2) following too closely while approaching to pass, i.e., cornering; (3) operator inattention, i.e., dozing at the wheel; (4) vehicle running off the road; (5) intersection errors; (6) errors in passing; (7) operating in wrong lane of traffic; (8) leaving and entering the roadway; and (9) pedestrian errors.[3]

It is possible that some of the near accidents are related to the personality and aptitude of the drivers, or that certain drivers have a tendency to become involved in the same type of situation repeatedly. Observations thus far indicate a characteristic failure of the driver to take "defensive" action, that is to say, there is a tendency to wait for the other driver to allow for margins of safety. This occurred in 95 per cent of the 66 incidents observed. The implications are clear that studies of near accidents offer an unusual opportunity for training the driver to anticipate hazardous situations and to avoid them.

[3] "Human Factors in Highway Transport Safety," by R. A. McFarland and A. L. Moseley, Harvard School of Public Health, Boston, Mass., 1954.

Layout of Working Space

In order to improve the ease, efficiency, and safety of operating all types of equipment, consideration should be given (1) to the application of anthropometric (human-body size) data to design, and (2) to its use in a dynamic setting. In many instances an engineer is given instructions to design the equipment and the operator's area in such a way as to "prevent reaching beyond range of vision," "avoid off-balance positions," and "provide adequate headroom and clearance." Rarely is he supplied with quantitative descriptions to meet these requirements.

On the other hand, if quantitative measurements are provided, the "average-value" fallacy is often committed. Although such values can be applied to special cases in the design of equipment, arrangements based on averages would be unsuitable for 50 per cent of the operators in a normally distributed group.

Instead of averages, percentile distribution tables should be used which show the measurements for given human dimensions in tabular form for each 5 per cent of the population, from the smallest or 5th percentile to the largest or 95th percentile. Thus, by choosing the fifth percentile as the minimum and the 95th percentile as the maximum, a vehicle may be designed to fit fully 90 per cent of the population—a desirable practice.

Design and Arrangement of Controls and Displays

In regard to controls and levers, many errors can be prevented if they are so designed and placed that rapid and accurate judgment and movements can be made. In the design of controls, particular attention should be given to the shape and color-coding of knobs, the radius of knobs and winding handles, the gear ratio, and the amount of friction and inertia.

Some of the important factors relating to the operation of controls are (1) their location for ease and accuracy of reaching, (2) direction of movement for greatest efficiency, (3) speed required in relation to rotary and wrist movements, (4) rate of movement from point to point, and (5) rate and accuracy of positioning responses. Unless controls are designed carefully, placed properly, and identified easily, they are apt to be operated inadvertently. The design criteria for many of these variables have been determined experimentally for aircraft, and we are now using similar techniques in studying automotive equipment.

The concept of design failure is relatively new and unexplored, partly because accident reports have failed to identify design failure. Design failures may be so subtle that those responsible for reporting the accidents may not even be aware of them, particularly if they are not trained to recognize such failures.

Another idea meriting study is that concerned with

the design and placement of switches and dials. The fundamental principle is to make the various switches of different sizes and shapes in order to eliminate errors of identification.

In regard to visual displays, accidents may occur if an operator does not clearly perceive the location or movement of the indicators, meters, or dials. A worker must receive clear and unambiguous information concerning his equipment, especially if several tasks must be performed successively or simultaneously for long periods of time.

The following factors have a significant effect on ease of seeing: (1) size and spacing of critical detail, especially in instrument markings and figures; (2) contrast between object and background; (3) amount of illumination, including the use of color, and (4) contrast between the objects to be seen and their surroundings.

Auditory signals should be recognizable against the background of the sound pattern, and attempts should be made to use a range where the ear is maximally sensitive with respect to frequency, intensity, and duration.

In the field of vehicular design two manuals concerned with such factors as human-body size and capabilities have been prepared by the author and his associates at the Harvard School of Public Health. One presents the pertinent data and methods of the human engineering approach while the second deals with specific evaluations of current vehicles.[4]

Environmental Factors Influencing Comfort and Safety

Additional factors influencing the efficiency and safety of workers relate to the physical variables in the environment. These may be broken down into temperature, humidity, and ventilation, noise, and vibration. Extremes of any of the factors will result in discomfort and lowered efficiency as well as the discontent of employees. For each of these variables there are reasonably well-defined ranges of comfort and discomfort.

A summary of the various stimuli influencing worker comfort and safety in terms of desirable and maximum values is presented in Table 1. The highest degree of comfort would be achieved by conforming to the comments listed in the "desirable" column. Discomfort might be expected to arise if the maximum values given in the last column are exceeded.

[4] "Human Body Size and Capabilities in the Design and Operation of Vehicular Equipment." Harvard School of Public Health, Boston, Mass., 1953.
"Human Factors in the Design of Highway Transport Equipment: A Summary Report of Vehicle Evaluation." Harvard School of Public Health, Boston, Mass., 1953.

The values indicated in the table cannot always be considered as rigid standards because of the interdependence of one variable with others.

Detection of Accident Repeaters

Since design factors can remove only certain types of accident-inducing situations, it is also necessary to approach the problem from the point of view of driving deficiencies inherent in the operator. For this reason

As our environment becomes more mechanized and our civilization more mobile, accidents will continue to increase at an alarming rate and many preventable injuries may continue to impair the working efficiency of our population. The preservation of health and the prevention of accidents can be achieved in industry only by the concerted effort of various biological scientists working as a team with specialists in public health and safety engineering.

an attempt should be made to determine whether some individuals are apt to be more liable or "prone" to accidents than others and have higher accident rates.

Studies of accident repeaters involve (*a*) the determination of whether there are important differences between individuals in their accident liabilities, and (*b*) if differences do exist, devising methods for detecting those individuals who are especially liable to accidents. Those individuals having repeated accidents are often impulsive, aggressive, and resentful of their superiors. Such persons also are frequently known to various social agencies and police courts.

Physical Standards for Selection

In the development of physical standards for selection, there has been disagreement not only as to whether they should be more strict or more lenient but also as to the functions to be measured and the tests to be used. Those who argue for greater leniency point to the lack of relationship between the findings on the physical examinations and accidents. The view presented here is that these questions can be answered only if (1) the physical standards and tests are functionally related to the requirements of the job, and (2) the tests measure these functions accurately and consistently, i.e, are reliable,

Table 1 Limits for Variables Influencing Comfort and Safety

Variable	Desirable	Max or min value for comfort
Ventilation	Sufficient additional fresh or recirculated odor-free air to remove all odors	20 cfm of fresh air
Air temperature....	Ambient temperature adjusted to give effective temperature of 63–71 ET (winter) or 66–75 ET (summer)	70–72 F dry bulb
Air velocity.....	Adjusted to ambient temperature to give appropriate cooling power without drafts	40–60 fpm
Humidity.....	Adjusted to air temperature and velocity to maintain comfort	25–50 per cent relative humidity
Carbon dioxide....	Not a requirement as long as ventilating requirements for removal of odors are met	0.5–1.0 per cent
Carbon monoxide..	None	0.003 per cent
Noise.....	Reduced to permit conversation at least 3 ft with no extra effort	80–85 db over-all and 30–60 db in 1200–2400 band
Vibration.....	Reduced to below threshold of perception	0.002 in. at 20 cps or more

and are evaluated against some objective criterion of proficiency, i.e., are valid. After determining what a man is expected to see and hear or what stresses he may encounter, the various tests in the physical examination can be directed toward these requirements.

Few systematic attempts have been made to integrate physical standards with the requirements of the job. In aviation, for example, tests for hearing have been given in quiet rooms where a pilot's ability to hear the required signals or speech in the presence of aircraft noise may or may not be appraised.

In the case of older, more experienced pilots, some leniency should be permitted. This is particularly true since those with hearing losses have more normal hearing in the presence of noise on the aircraft. Older pilots with hearing losses therefore should be tested in simulated aircraft noise. If the hearing losses do not interfere with intelligibility of normal conversation, safety would not be compromised.

Psychological Standards for Selection

The initial step in a successful selection program involves a precise description of each job as it relates to the requirements and abilities of the workers. In more complex jobs it is not sufficient merely to catalogue the various movements and tasks expected of the operator, but more particularly the sense of timing and the ability to understand subtle cues, to make judgments, and to anticipate future situations should be investigated. The ability to maintain emotional control under operating conditions must be evaluated.

Significant information can be obtained from recorded materials, such as training manuals and personnel files, interviews with those who possess an intimate knowledge of the job, analysis of direct experience by sampling methods, and objective techniques, such as wire recorders and motion-picture photography.

In order to arrive at a well-rounded evaluation of an applicant's psychological make-up, appraisals of proficiency on several traits should be made. This involves the development of a group or battery of tests based on (*a*) accurate job descriptions, and (*b*) a valid success-failure criterion.

Numerous statistical techniques are available for obtaining the best possible groupings of such tests in order to arrive at an over-all evaluation of a candidate. The various tests of a battery often show a low intercorrelation and are assigned different weights based on an empirical analysis. An ideal battery should predict the success of most applicants above a combined critical score and the failure of those below it.

Changes in Function as a Result of Aging

Since physical fitness and sensory functions deteriorate as a man grows older, a fair estimate of his capacities and abilities at any given period will depend on a knowledge of the amount of deterioration that normally can be expected at that time. Although compensatory changes of method may appear with age, the difficulty of dealing with new and complex information rapidly militates against older persons from comparatively early ages. These changes may vary greatly from one person to another in both nature and extent, but even minor deteriorations in many of the psychological and physiological functions may interact to produce a significant loss in over-all efficiency.

Although all the sense organs of the body show a loss of sensitivity with age, important changes occur in vision. Visual functions, such as accommodation, acuity, depth perception, and dark adaptation are kown to be influenced adversely by the aging process. These changes, however, are of less significance than is frequently supposed and hardly great enough to impair performance, even for a pilot, until he reaches the age of 50 years or over. The loss in auditory sensitivity occurring with age is rarely sufficient to create an operational hazard.

In so far as mental ability is concerned, there are definite changes in such functions as ability to learn, memory, reasoning, and judgment, especially in relation to speed or ability to deal with complex factors within given units of time. Compensation takes place for every deviation, however, and if certain capabilities diminish others are enhanced. Thus, if a fairly profound decline sometimes occurs, compensation and changes in method often result, so that final achievement changes relatively little or at times may even increase. In regard to undertaking new tasks or duties, various studies show that attitude and motivation are often as important in the end result as deterioration in innate capacities.

Epidemiological Approach to Accident Control

The control of accidents falls within the province of preventive medicine and public health as do such fields as industrial hygiene and sanitary engineering, because of the important role played by human variables. It is not generally appreciated that injuries, as distinguished from disease, are also amenable to the epidemiological approach and that accidents follow some of the same biological laws as do disease processes. In most instances there is multiple causation and attempts at control should involve consideration of the interaction of agent, host, and environment; i.e., the vehicle, the driver, and the highway. Although the host is of primary medical concern, the agent and the environment also must be considered in effective preventive measures. This applies equally to military and civilian populations, under all conditions, including combat.

Attempts should be made first to set forth the basic physical, physiological, and psychological characteristics of the host or drivers. When such facts are associated with the agent under given environmental conditions and at specific times and places, information can be obtained so as to understand and prevent accidents. Factual information of this type can be discovered only by carefully controlled experimental studies, epidemiological surveys, and statistical analysis. A dynamic and continuous safety program can produce positive results only by the constant application of the fundamental principles resulting from such studies.

High-Speed Photography

An ideal tool, or instrument, for the analysis of motion

By John H. Waddell

Wollensak Optical Company, Rochester, N. Y.

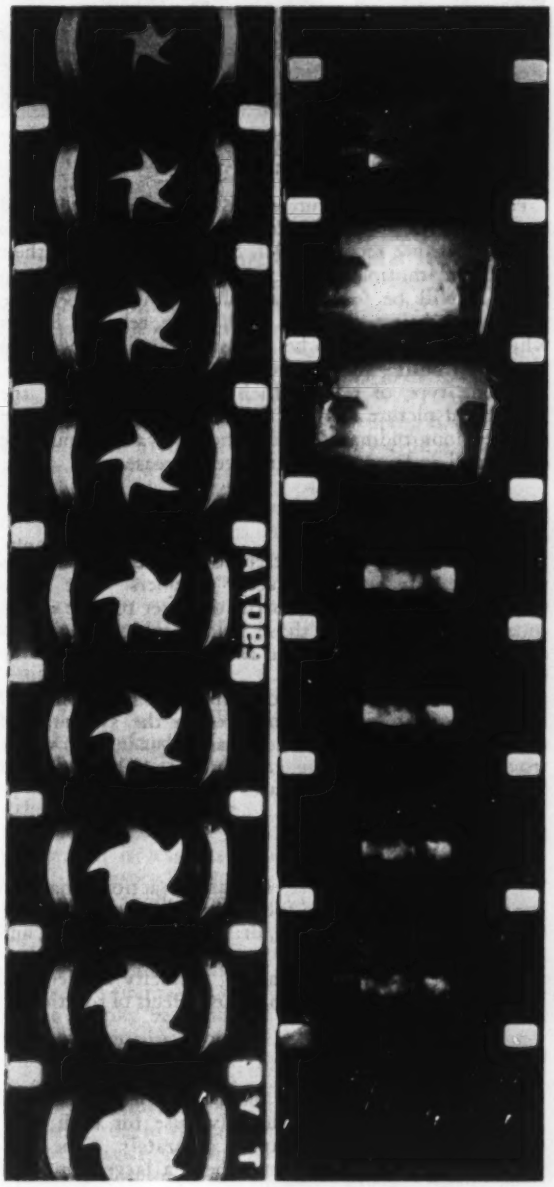

Fig. 1 Strip at *left* shows opening of shutter blade; 8000 pictures per second. In strip at *right* the action of a fuse blow-out occurring in one millisecond is shown at 8000 pictures per second; 8 seconds = 1 millisecond.

In the mechanical-engineering field, most of the operations and the actual performance of the finished product are occurring too fast for the eye to see. A shaft which is rotating at 3600 rpm or 60 rps appears only as a blur when observed visually, or when recorded with a normal-speed motion-picture camera. With modern methods in photography that shaft can be made to rotate at 1 revolution every $8^1/_3$ sec with a 16-mm high-speed motion-picture camera, or $16^2/_3$ sec per revolution with an 8-mm high-speed camera.

Spring Design Studies

Springs have been one of the troublesome subjects in design for a long time. A handbook will give a formula for the design of a desired spring, but when it is fabricated and put in use, it might be found to break after a limited number of operations. It may have undesirable nodes and wave actions which cause chatter, or it might be maladjusted so that excessive vibration or bouncing might occur in parts connected with the spring, such as cams and followers, or have other malfunctioning. The former procedure was to change the spring material, or to alter the thickness, or to make the other changes that the engineer might think prudent, and as the condition was either worsened or bettered, these changes might go on endlessly.

The basic forms of the spring are the coil, the flat, and the helical. Each has a major duty to perform in a coordinated mechanical study.

Coil Springs

With the coil spring the major functions are to restore position after operation or to act as a driving medium such as a belt. When these actions are taken with the high-speed camera, phenomena, such as bounce of the adjoining parts when the spring is operated, easily can be studied. The spring tension might be a "hairline" adjustment so that this bounce does not appear on every operation—a study which the stroboscope would not pick up. The spring tension might not be adjusted correctly and a clutch will engage erratically or bounce, thus causing the clutch teeth or pads to be malformed. There may be secondary vibrations in the spring movement which will cause it to chatter or fracture.

Spring belts are notoriously "bad actors," particu-

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Fig. 2 High-speed motion-picture camera is used to study ignition at Parker Pen Company, Janesville, Wis.

Fig. 3 The action of drill presses is analyzed with a high-speed camera.

larly when operating at high speeds. (It might be mentioned that belts of all categories make excellent subjects for study—flat, V, chain, etc.) In one type of high-speed motion-picture camera, now obsolete and superseded by a much finer one, a spring-belt drive was used to transmit motion from the driving unit to take-up spool. The ultimate velocity of the film was 50 fps, but one look at the high-speed picture of the $^1/_8$-in. belt drive at that speed made one wonder how the belt worked at all.

When a coil spring is linked in with another unit, such as a valve lifter and camshaft, the problems become more involved and the obtaining of measurements necessary. If the valve spring is maladjusted, the valves will bounce and cause fuel vapors to be fed at the wrong time, or an improper mixture of fuel and air to be taken into the cylinders, or it may cause the followers on the camshaft to follow the cam improperly and bounce. If that bounce occurs regularly, there is a permanent deformation of the camshaft causing the engine to misbehave.

General Motors was the first automotive manufacturer to employ high-speed motion-picture cameras to study such actions, and shortly thereafter its example was followed by the other major builders of cars. But some of the independents did not follow suit, much to their regret. An initial investment of no more than $4000 and 100 or 200 rolls of film would have saved them far more.

Flat Springs

The flat spring is another "misbehaver" from the standpoint of vibrating members. The most common forms of the flat springs are used in relays and in friction or tension devices. Where they are used in relays, they are generally supported or fixed at one end while the other end supports the contacts for the opening and closing actions. In many cases, studs or buffers, which are insulating materials, will be placed somewhere along the springs, to provide permanent separation of the relay springs or to break up standing waves which occur on the operate or release. High-speed photography permits relay studies for a number of repetitive operations for the analysis of (*a*) the behavior of the springs, (*b*) the contact bounce and effect of arcing on the contact points, and (*c*) the true operate and release time.

Few relay manufacturers have secured high-speed cameras for these simple analyses, but if one examines the performance record of Bell System relays since their high-speed motion-picture analyses were started in 1932, it will be found that outstanding performance records are being obtained with their relays. Relays which were thought to be almost impossible to design have been built—and they work.

In one type of relay which has been studied, the high-speed picture showed that if the stud was moved slightly longitudinally, the standing waves would be eliminated and contact chatter would cease.

Helical Springs

The helical spring has presented trouble near the ends which are attached to adjacent members. The high-speed motion picture allows the observer to note differences in elasticity near those points, which might become fatigued much sooner than would otherwise be suspected.

With materials in contact, vibration is transmitted from one member right on through the system, and consequently wrong deductions can be made as to where trouble actually is being encountered. The action of springs is one of the first places to look for trouble.

Variety of Other Studies

Among the many other mechanical actions that can be studied are: Cams and followers; clutches; machine-tool behavior such as lathes, drills, millers, shapers, and saws; Geneva movements; gears; tensile-strength testing; shock; vibration; impact; velocity acceleration and deceleration measurements; and effects of rotation.

Using High-Speed Cameras

When high-speed motion pictures are used, it should be remembered that it is usually wise for each component part to be photographed separately. The average human mind cannot comprehend a large number of items moving simultaneously on a screen. The rules of simple photographic composition also should be followed in the taking of pictures for analytical purposes.

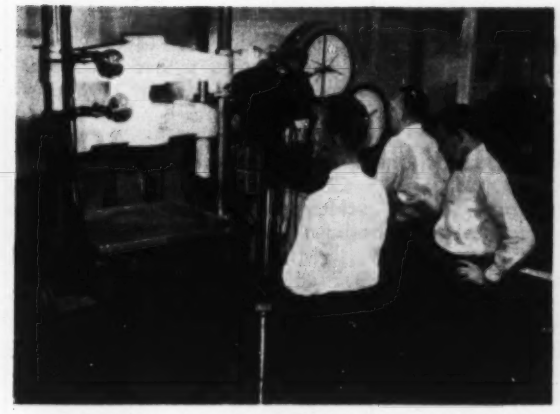

Fig. 4 Tensile-strength measurements are studied by high-speed photography, at Corning Glass Works.

Fig. 5 High-speed camera studies internal reaction of a blast furnace at United States Steel Corporation.

Color film can be used as easily as black-and-white film with the improved light sources that are available today. Special printing or finishing to increase subject contrast is no longer necessary. The natural colors themselves will delineate the component parts. Color film easily can be exposed at rates up to 8000 per sec with incandescent tungsten sources and in excess of 1000 per sec out of doors on bright clear days. And with new color films which are coming, performance now obtained with high-speed commercially available black-and-white film will be equaled.

General High-Speed-Camera Facts

The cameras commercially available today are designed ruggedly and with ease of portability in mind. They are constantly being improved or modified for specific usage by engineers, so that the widest possible application can be made of them. They are being produced and sold at a price which is less than many laboratory instruments whose applications are far more restricted. Auxiliary equipment is being designed to increase the camera's adaptability, so that it may be hand-carried up mountains, used on the desert, in the arctic and tropical regions, in the air, in the laboratory, or in diving bells. Optical systems have been developed so that the cameras can be used on the microscope or that an object 1 in. in size can be observed 5 miles from the camera. Picture-taking rates are easily adjustable since series motors are used and the voltage supplied governs picture-taking rate, whether it be a-c or d-c. These picture-taking rates vary from 150 to 16,000 per sec and in frame sizes from 8 mm to full-frame 35 mm. The photographic quality of the rotating-prism cameras is approaching that of intermittent cameras in sharpness, in contrast, and in resolution. In some of the high-speed cameras, the steadiness and lack of weave, or bounce, is better than in the intermittent cameras.

Fig. 6 The action of a beater in an electric mixer is typical of a high-speed study.

Control Units and Light Sources

Control units have been designed to control camera running time and voltage supplied to the cameras, as well as to synchronize the event being studied with the camera. Better film for high-speed motion pictures is being produced so that with the higher inertia films, grain size is kept at a minimum.

Light sources, mainly tungsten-type incandescent constantly are being improved so that color and black-and-white pictures can be made at smaller stops so as to gain the advantage of increased depth of field. In addition, the electronic flash has been synchronized to work with these cameras.

Imginative use of high-speed photography can result in improved design, better performance, and decreased costs.

Engineering Developments of Rubber—

July, 1952–June, 1953

By Betty Jo Clinebell

Librarian, Rubber Division Library, University of Akron, Akron, Ohio

Rubber-Industry High Lights

Plan to dispose of government-owned synthetic-rubber plants

Government controls on rubber consumption removed

Use of rubber in 1952 reached almost all-time high

New record expected for 1953

Lower prices for natural rubber

THE most important news during the past year in the rubber industry has been the development of a proper plan to dispose of government-owned synthetic-rubber plants to private industry. Legislative action has been taken on this matter. The report of the Reconstruction Finance Corporation to the President and Congress on synthetic-rubber-plant disposal was made public March 2, 1953, and generally was received with approval by the Congress and the industry (1).[1] In May, Representative Paul W. Shafer introduced a plan for selling the $500,000,000 government-owned plants to private industry (2). By August 7 the synthetic-plant sales bill had been approved by the President and Congress, after much debate and some changes in the bill. The compromise bill calls for the sale of the plants by January 31, 1955, subject then to 60-day review by Congress (3, 4, 5, 6). A three-man Synthetic Rubber Facilities Disposal Commission was expected to be appointed by the President in September, 1953 (7).

In May, 1953, after 12 years of continuous government controls over the consumption of rubber, the National Production Authority removed all controls by revoking NPA Order M-2 (8, 9).

The outlook for the rubber industry is bright, as new records of production and consumption are being made. The use of rubber in the United States in 1952 came within 221 tons of equaling the all-time record set in 1950. Synthetic rubber accounted for 65 per cent of the total rubber consumed. Consumption for 1953 was expected to hit a new high (10). Bearing out this forecast, consumption of rubber for the first 3 months of 1953 set an all-time record, increasing 15 per cent over the first-quarter consumption of 1952. Synthetic-rubber consumption continued to be 65 per cent of the total as in 1952 (11). Production figures for the first 5 months of 1953 showed a slight increase, about 5 per cent, in synthetic-rubber output, and a 5 per cent decrease in natural-rubber production, compared with the first 5 months of 1952. Consumption for this period in 1953, for both natural and synthetic rubber, increased over the first 5 months' period of 1952 (12). Oil-extended and cold GR-S showed increases in consumption in 1952 over 1951, while regular GR-S consumption decreased (13).

Since June, 1952, the price of natural rubber has decreased from 30 cents per lb to 21½ cents per lb in August, 1953 (14, 15). The price of synthetic rubber has remained at 23 cents per lb since March, 1952 (16). In July, 1953, the price of butyl rubber was increased from 20¾ cents per lb to 23¼ cents per lb. The lower price had been in effect since December, 1950 (17).

Cold Rubber

Several modifications of the compounding and manufacturing processes for "cold rubber" have been developed. A new fast process utilizes an extremely active hydroperoxide catalyst and stainless-steel pipe-line reactors, whereby butadiene and styrene can be polymerized 50 times as fast as by the conventional process, at the usual cold-rubber temperature of 41 F. Polymerization by the new process requires only 15 to 20 minutes, instead of the 10 to 12 hours now required. After polymerization, the latex is coagulated, filtered, washed, and dried just like regular GR-S. The quality of the

[1] Numbers in parentheses refer to the Bibliography at the end of the paper.

Contributed by the Rubber and Plastics Division and presented at the Annual Meeting, New York, N. Y., November 29–December 4, 1953, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

polymer produced is comparable to that of standard cold rubber and has the advantage of a saving in capital investment over a conventional GR-S polymerization system. It is estimated that one commercial unit can produce as much as 24 conventional autoclaves (18, 19, 20).

A further development of this particular accelerated process is its application at 122 F, producing GR-S comparable to regular "hot rubber," while retaining the advantages of speed and installation-cost economies (21).

A new chemical activator that is claimed to reduce the manufacturing costs of cold GR-S, to speed up its production, and to make a more uniform product has been announced recently. This material has been named only as "a sulfoxylate derivative." Laboratory tests indicate the rubber may have better aging characteristics than present types as a result of low iron content (22).

An outstanding development of 1952 is the extension of cold rubber with rosin, in a procedure similar to that employed in extending GR-S with petroleum oils. Laboratory tests on tire-tread and carcass vulcanizates have shown improvement over corresponding regular cold-rubber vulcanizates in a number of respects, i.e., as much as 50 per cent better Lambourn abrasion resistance, up to 30 per cent higher tensile strength at room and elevated temperatures, up to 15 deg lower temperature rise on flexing, superior flex-cracking resistance, and superior aging resistance (23, 24).

Two papers that discuss recent technical advances in the field of low-temperature polymerization have been published (25, 26).

Carbon black can be dispersed readily in GR-S rubber by being jetted into the latex with a high-pressure steam jet. The new process is said to reduce both initial and processing costs of the rubber. In an 18,000-mile road test, tires produced from the steam-jet cold GR-S showed a 20 per cent improvement in tread wear over control tires of the best cold GR-S produced by other methods (27, 28).

The results of a study of the effects of a number of polymerization variables on the tensile properties of films from cold GR-S latex should be useful in the production of improved synthetic-latex films (29).

Other Types of Rubber

Oil-Extended GR-S. Oil-extended and plasticized GR-S, a development of 1951, is made by adding substantial proportions of petroleum oils to the synthetic latex before coagulation, resulting in a material equal to or superior to other types of rubber at a lower production cost. This type of rubber, when compounded properly, gives tread wear as good as or better than cold GR-S.

Studies indicate that the chemical composition of the oils used as extenders may have pronounced effects on some of the physical properties of the oil-enriched rubbers. These oils may have a wide spread in chemical composition and physical properties and therefore an oil should be selected to give the best over-all balance of properties desired in the final rubber product. Compatibility, processibility, and low-temperature properties are the most important factors to be considered (30, 31).

Nitrazole Rubber. Another type of GR-S synthetic rubber comparable to cold rubber and superior to regular GR-S in physical properties can be produced in non-refrigerated equipment, at 122 F, with the aid of a polymerization catalyst, Nitrazole CF (p-nitrobenzene diazonium p-chlorobenzene sulphonate). Both Nitrazole rubber, as it is called, and cold rubber have good abrasion resistance. Road tests of Nitrazole rubber have shown promising results. The improved properties of the synthetic apparently stem from a superior molecular-weight distribution achieved by the catalytic rather than low-temperature polymerization. The use of this polymerization system eliminates the expense of refrigeration equipment, and Nitrazole CF is no costlier than other catalysts being used at present (32, 33, 34).

Alfin Polymers. Alfin catalysts offer a distinctly new method of producing a very tough synthetic rubber, which previous studies have shown to have some properties superior to GR-S. A general description of Alfin rubbers has been published. Alfin rubber compounds show, in general, superior abrasion resistance, very high flex life, and excellent aging properties. The polymer has the interesting property of being set or vulcanized by heat without the necessity of incorporating sulphur (35). Polymerization and copolymerization reactions with Alfin catalysts have been studied in order to lay a firm foundation for pilot-plant development of the process. At the present time Alfin polymers are still in the laboratory stage (36).

Manufactured at 41 F under refrigeration, "cold rubber," in contrast to regular GR-S or "hot rubber" produced at 122 F, offers greater tread-wear resistance even than natural rubber. So great are its advantages that 55 per cent of the total GR-S being produced is cold rubber.

Vulcollan. The properties of Vulcollan, a polyester rubber developed and marketed in Germany, are said to be better than the properties of the conventional natural and synthetic rubbers. However, Vulcollan is difficult to process and is rather expensive. The synthetic rubber is a condensation polymer of glycols and adipic acid. Vulcollan is said to be well-suited to the manufacture of heels, insoles, solid tires, cycle tires, and cable covers. Heels made of Vulcollan have been reported to wear about 10 times as long as heels of natural rubber (37, 38, 39).

Chemigum SL. A polyester synthetic rubber similar to Vulcollan but without the processing difficulties has been developed in the United States. Chemigum SL, as it is named, has tensile strength of well over 5000 psi without carbon black, good resistance to abrasion, and high tear strength. This synthetic is a condensation polymer of a low-molecular-weight polyester adipate with a diisocyanate and can be vulcanized speedily. The new rubber is supposed to hold air like butyl, to have oil resistance like neoprene, and to have oxidation resistance superior to that of natural and other synthetic

rubbers. According to reports, tire treads of Chemigum SL show 2 to 5 times greater wear resistance than those made from the best cold GR-S. However, until the non-adherence of the new synthetic to other rubbers is overcome, its use as a tough skin for tire treads cannot be realized. Other potential uses are as heels, soles, and conveyer belts, and as protective coatings for heels, soles, belt surfaces, floorings, etc. (40, 41, 42, 43).

Hydropols. A series of thermoplastic hydrogenated polymers, Hydropols, have outstanding freeze point, oil resistance, and tensile strength. These materials result from the hydrogenation of synthetic elastomers such as polybutadiene and copolymers of butadiene with various vinyl compounds. Hydropols are flexible at very low temperatures; for example, hydrogenated polybutadiene can be struck sharply at —100 F without shattering and is not brittle (even though extremely hard) at liquid-nitrogen temperatures. Some of the more important potential applications are in wire and cable coating, films, tubing, and various molded items (44).

Hypalon. Further investigations of Hypalon (chlorosulphonated polyethylene) show exceptional resistance to chemical and solvent action, to the effects of oxidizing agents, to absorption of liquids, and to attack by ozone and oxygen (45). The blending of small amounts of Hypalon with other elastomers results in an improved resistance to ozone degradation (46). Blends of Hypalon and GR-S have also been investigated. GR-S blends containing 25 per cent or more Hypalon give tread stocks with improved ozone and abrasion resistance, as well as improved heat-aging characteristics. However, the development of a suitable curing system for these blends presents unusual problems because of the differences of the chemical structures of the individual elastomers. Field evaluations of these blends have been started (47).

Hard Rubber. High-styrene resins are well known for their hardening and stiffening action in soft-rubber compounds. This same principle has now been applied to hard-rubber stocks with equal effectiveness. Blends of high-styrene resins and hard-rubber compounds give products with improved impact strength and appearance. Processing and preforming of the resin stocks are said to be improved also. By using the resins to promote a portion of the hardening and stiffening action in the hard-rubber compound, it is possible to reduce the sulphur content of the compounds (48).

Ebonite articles manufactured from latex are said to have mechanical properties superior to those from corresponding dry rubber mixtures. These superior mechanical properties are ascribed to the fact that in latex processes the rubber molecules have kept their original length. Steel can be coated with latex ebonite, and the same adhesion is obtained as with the conventional ebonite solution. Latex ebonite can be applied as an anticorrosion coating for metal parts of intricate shapes, such as stirrers, baskets, turbines, and so on. It is claimed that latex-ebonite articles generally are less expensive than dry-rubber ebonite products (49, 50).

Reclaimed Rubber. A new kind of reclaim in powdered form has been introduced. The powder is free-flowing and suitable for automatic handling. A variety of reclaim powders can be produced in a wider range of plasticities than is possible by the use of conventional reclaiming equipment (51). A practical process has been developed for reclaiming ground rubber scrap by using microorganisms for the removal of cellulosic material, yielding neutral reclaim of good quality at low cost (52). Improved reclaiming methods for obtaining fiber-free reclaim from tire rubber have been discussed (53). The discoloration of light-colored stocks as a result of migration of staining materials from reclaimed rubber in adjacent stocks, as in white-sidewall tires, can be reduced by incorporating active carbon in the reclaim (54).

Miscellaneous Types. A new series of fluorocarbon rubbers are said to have good high-temperature stability and excellent resistance to attack by ozone, fuels, lubricating oils, hydraulic fluids, and the like. They are polymers of dihydroperfluoroalkyl acrylates and are vulcanized easily. The properties of these new rubbers recommend them especially for automotive and aircraft applications (55, 56, 57).

Another rubber suitable for aircraft applications results from the addition of a mineral filler, mostly clay, to nitrile-type synthetic rubbers. This filler serves to reduce the swelling of the compound when immersed in aviation fuel and also improves electrical properties and elevated-temperature resistance. The rubber can be bonded to metal with the usual rubber-phenolic adhesives (58).

A general description of the requirements for rubber-like materials for the newer jet bombers and supersonic fighter aircraft has been published (59).

Studies show that the oil-resistance of nitrile-rubber vulcanizates depends primarily on the butadiene/acrylonitrile ratio. As acrylonitrile content is increased, oil resistance increases (60, 61).

The tensile and elongation properties of silicone rubbers can be approximately doubled by the incorporation of ultrafine silica pigments. The new compounds are being used experimentally in automobile tires and V-belts (62). The superior low-temperature characteristics of silicone rubbers in comparison with natural and GR-S rubbers have been demonstrated. In a study of low-temperature behavior, the silicone rubbers did not show appreciable stiffening until some temperature between —112 and —130 F, while natural and GR-S rubbers were stiff at —76 F (63).

The acrylate rubbers possess outstanding resistance to oils and have high-temperature resistance second only to the silicones. Copolymers of acrylates with acrylonitrile have somewhat better physical properties than earlier types, while retaining their advantages (64).

Butyl rubber has almost completely displaced natural rubber for pneumatic inner tubes (65). Leather impregnated with butyl rubber provides soles which have the same greatly improved abrasion and water resistance as leather which has been impregnated with natural rubber. In addition, the use of butyl rubber reduces the time required for the milling operation and also saves time, labor, and materials in the tannery (66).

In tests over a ten-year period, properly compounded neoprene vulcanizates have shown creep resistance equal to or better than that of natural-rubber vulcanizates (67).

Applications

Tires. Techniques for the measurement of tread wear of commercial tires have been improved by studies at the National Bureau of Standards. The most efficient method was found to be the weighing of the complete

tire on a sensitive balance. Results show that reliable estimates of tread life can be made from 4000 to 6000 miles of road test using the improved techniques (68).

The development has been described of a tire tester which evaluates resistance to flexing fatigue and cut growth, running temperature, and tread life, all of which heretofore required separate testing. The tester track is $^1/_{60}$ mile in circumference and will accommodate 18 tires simultaneously. It can be regulated to speeds between 22 and 66 mph (69).

An investigation of the effect of test severity on the relative ratings of natural rubber, regular GR-S, and cold GR-S tread compounds shows that the rate of wear is affected greatly by the severity of the test. Both laboratory and actual road-wear performance data show that synthetic rubber and natural rubber are fairly similar in rate and wear under mild conditions of testing, but in severe service the synthetic rubbers are vastly superior to natural rubber (70).

The winter-driving behavior of tires made of natural rubber and synthetic elastomers has been studied. Results show that natural-rubber tires have better traction and acceleration on snow and ice, but that some synthetic elastomers are superior on wet pavement and turning corners on ice (71).

To study the skidding of automobile tires, a machine consisting of a circular aluminum ice tray that turns under rubber test blocks measures the amount of friction between the rubber and the ice. Results show that temperature has the greatest influence on tire friction on ice. At the lowest test temperature, from about —22 to —40 F, the coefficient of friction is just about twice its value at a temperature just below freezing. The kind of rubber and its hardness also affect friction (72).

A new term, "abrasion pattern," describes the array of nearly parallel ridges produced by abrasion on rubber surfaces. The ridges run at right angles to the direction of abrasion, and their profile is asymmetrical with respect to the direction of abrasion. This abrasion pattern has been used to explain the mode of abrasion of tires (73).

A test machine claimed to be the fastest of its type in the world has been developed to reproduce landing, taxi, and take-off conditions of airplane tires of present and prototype jet aircraft up to 3000 rpm, with a maximum speed of 300 mph. It tests tires ranging in size from 17 to 37 in. tread diameter under loadings up to 8 tons (74).

A new test procedure for measuring tire-cord fatigue resistance shows good agreement with actual tire-performance data. Studies show that loss in tire-cord strength stems from broken filaments and from a small loss in fiber strength throughout the tire, and not from abrasion or heat degradation. The Goodrich disk-type tester showed the same relative rate of strength loss for rayon and cotton cords as was found in a passenger-tire fleet test (75).

Mechanical Goods. A new "flowed-in" gasket which is applied as a liquid synthetic rubber or resin compound and then baked to a solid rubbery gasket is said to provide an improved seal at lower labor and material costs. The gaskets can be made in varying formulations, types, thicknesses, and diameters (76, 77).

Two articles on the continuous vulcanization of cables have been published in the past year (78, 79).

On the basis of laboratory tests, sodium-catalyzed polymers, because of their good electrical properties, would be useful for wire and cable stocks. The properties of these polymers are superior in some respects to the properties of polymers now being used for wires and cables (80).

Coatings. A symposium on emulsion paints which was presented before the Division of Paint, Varnish, and Plastics Chemistry at the 122nd meeting of the American Chemical Society in September, 1952, covered the chemistry and technology of the so-called latex or rubber-based paints (81 to 90). The growth of latex paints can be seen in an estimated doubling of production each year since 1949 (91, 92).

Over a dozen protective-coating systems for steel which offer excellent protection against distilled and sea water and against solvents have been developed using Thiokol polymers as the basic chief constituents. An accelerated method of performance testing was devised to test resistance to distilled water, synthetic sea water, and a synthetic sea water-SR-6 test solvent mixture (93).

Each year many new and different applications of rubber appear. With the development of new and better synthetic rubbers and the improvement of older types of rubbers, there seems to be no end to the possible uses of rubber.

It has been found that a synthetic rubber-based paint, designed to cover tiny surface variations with a smooth aerodynamic film, is pushing up jet-aircraft speeds. The paint is formulated to resist attack by aromatic fuels and rain erosion at high speeds (94).

A new product made of liquid synthetic rubber and dry cement is claimed to make cement last indefinitely. The coating, called "Surco," is said to have excellent adherence to steel, glass, wood, stone, or concrete, to stand up under vibration or impact, to take colors and polishing for ornamental floors or walls, to preserve the steel that reinforces concrete, and to prevent damage by moisture (95).

The biological deterioration of polysulphide polymers used as linings for underground gasoline-storage tanks has been found to be due to the action of molds and bacteria, which enter the tanks from the soil. The addition of pentachlorophenol to the polysulfide-latex dispersion from which the linings are prepared is an effective method of control (96).

Pavements. Studies being conducted by the U. S. Air Force indicate that most of the injury done to bituminous pavement by fuel spilled from jet airplanes can be avoided by using coal tar with which synthetic rubber has been blended as a binder for such pavements (97).

The "rubber-roads" program being sponsored by the Natural Rubber Bureau was continued in 1952. Installations have been made in 19 states and 3 provinces of Canada (98).

Adhesives. A number of generally satisfactory one or two-coat organic cements are available for securing adhesion of rubber to steel; however, where a high-

strength durable bond is required as in motor mounts, much of the industry has continued to rely on the combination of brass plate and adhesive. An investigation concerned with the development of a one-coat replacement for the brass-plate system has shown that a new series of diene-unsaturated acid copolymers possesses exceptionally high adhesion to rubber and steel (99).

A new silicone product, Silastic XC-270, compares favorably with conventional pressure-sensitive adhesives at room temperature. It retains its high adhesive strength at temperatures ranging from —55 to over 300 F (100).

Other Applications. Possibilities exist for the use of considerable quantities of rubber aboard ships in various decking applications, such as synthetic-rubber matting, standing mats, latex-mastic compounds, and seam calking (101).

Ozone Degradation

A dynamic apparatus has been developed for the accelerated evaluation of ozone-protective agents for elastomers. By a simplified rating system a nontechnical person can rate a large number of specimens rapidly and without elaborate equipment. The method has been found to give results which correlate well with outdoor tests (102). The quantity of ozone absorbed by rubber can be determined by a new method and apparatus. This method can be used also to study the reaction of ozone with antioxidants (103).

The depth of attack of ozone upon rubber articles is influenced by such variable weather factors as moisture, temperature, and light. In a study of the influence of ozone-exposure temperature on the depth of ozone attack (at an ozone concentration of 25 pphm) it was found that in the range of —20 to +60 C, the most severe ozone attack took place at 40 C. Light was found to decrease the extent of ozone attack on a compound under either static or dynamic elongations. Depth of ozone attack is at a minimum at optimum cure (104).

Testing

Testing. The effect of mineral-oil swelling agents on the stress-relaxation properties of various rubbers has been investigated. The results show that continuous stress relaxation is inhibited by the presence of oil, and that unconfined swelling measurements predict the degree of inhibition directly. The swelling characteristics of the different elastomers in oils is of importance in their use for O-rings and other types of gaskets which undergo compression in service (105).

By the use of radioactively labeled gases containing carbon-14, it was found that the differences in permeability of natural and some synthetic rubbers are due mainly to the differences in the rate of diffusion and only slightly to the differences in solubility and rates of evaporation (106).

A new method and apparatus studies the oxidation and aging of elastomers by partial oxidation in solution in a sealed autoclave at 198 C. Three hours in the "water bomb" at 198 C are said to be equivalent to 192 hours in an oxygen bomb at 80 C (107).

A simple test for the quantitative measurement of the flexibility of rubber products has been devised. The equipment is inexpensive and can be homemade (108). For flexcracking and crack growth tests, the DeMattia test has been chosen for international standardization (109).

The adhesive strength of bond of rubber materials to metal can be measured by a newly developed rubber-strip-adhesion tester. This apparatus is used in measuring the force required to separate a rubber strip from a metal base at a definite jaw-separation speed and with the separating force applied at right angles to the base, thereby providing reproducible test conditions (110).

It has been found that the reliability of Mooney viscosity measurements can be improved by a few changes in design and technique. It is recommended that: (*a*) Radial V-grooves replace the serrations on the rotor and dies; (*b*) chromium plating of the rotor and dies be eliminated; (*c*) die and die holder be constructed as an integral unit; and (*d*) the speed of the rotor be reduced to 0.1 rpm or less for rubbers having very high molecular weights (111).

An apparatus and method for studying the behavior of motor-mounting compounds under continuous shear load and with simulated service conditions has been described. Serviceability is judged by two parameters: the amount of creep under continuous load, and the change in tangent modulus (112).

The use of a quick-acting wrench as an alternative for the conventional bolted-steel-plate device in determining the low-temperature-set properties of elastomers has been investigated. The quick-acting wrench compression-set apparatus has been found to be superior to the screw-type device with respect to duplication of compression-set ratings, accuracy of short time (10-sec) compression-set values, and ease of manipulation (113).

A laboratory machine for use in buffing strip samples of rubber materials has been modified so that rough strips having maximum dimensions of 24 in. × $1^1/_4$ in. × $^1/_2$ in. can be buffed to a predetermined thickness with a tolerance of 0.001 in. over the entire buffed surface (114).

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Welding Tubes to Tube Sheets

Brazing Process Used on Tubes of Unfired Heat-Transfer Equipment

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THE joining of tubes to tube sheets by any of the welding processes presents problems, some of which involve very special considerations in welding design. Assuming that the tube and tube sheet are of the same metal, then the problem may be resolved into one of relative thicknesses of tube and tube sheet. In such an assembly, as a general proposition, welding of a joint in which the thicknesses of the members differ by more than a ratio of about 4 : 1 is exceedingly difficult and under some conditions may be impossible without burning the thinner member. Under such circumstances brazing is a possible solution but may be restricted because of the size of the assembly and availability of suitable means for heating. The size of the ligaments in the tube sheet between tubes may be another controlling factor on thickness. In addition to the problem of relative thickness and size, one other variable may be introduced in the form of different base metals to be joined, in which case the tube sheet will be of one metal while the tubes are of another metal, e.g., stainless-steel tube sheet with copper tubes.

Joint Design

In general, it should be obvious that a joint between the tube and tube sheets must be tight under the operating conditions of expansion and contraction, corrosion, and chemical attack, in addition to pressure or vacuum. While many tube-tube sheet assemblies are made employing mechanical methods to lock the joints together and a weld (if used) merely serves as a seal, this paper is concerned only with assemblies in which the weld is used as the principal means of connection. However, it is a wise precaution to roll the tube into the tube sheet to provide uniform intimate contact between the tube and tube sheet for welding.

Many fundamental types of joints for welding are covered in the AWS Handbook (1)[3] but relatively few are suitable for tubes to tube sheets. The straightforward butt joint which generally is considered the best from the point of view of strength and reliability cannot be used under these circumstances. The tube and tube sheet meet in what is essentially a T-intersection

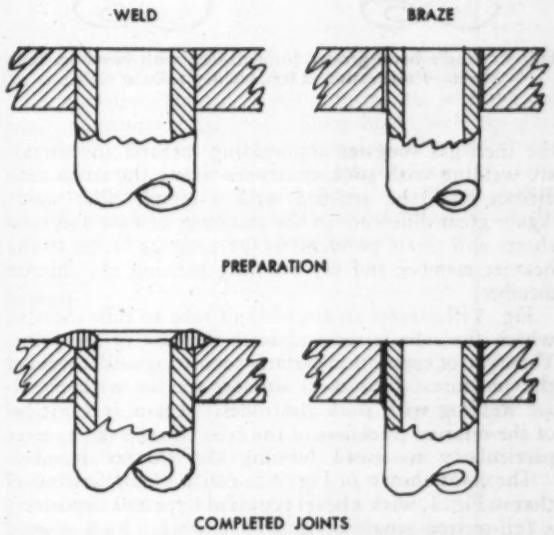

Fig. 1 Joint design with tube flush with tube sheet

although under some circumstances may be considered an L, and it is this disposition of the end of the tube with respect to the surface of the tube sheet that has a considerable influence on the method of welding which may be employed.

In the assembly shown in Fig. 1, the tube is essentially flush with the exposed face of the tube sheet. No other preparation is employed and about the only type of weld which can be applied here is a bead or edge weld. This in itself is of relatively low strength and would be suitable only for low-stress conditions. Some difficulty might be encountered in securing proper fusion between a heavy tube sheet and a thin-wall tube without burning the edge of the tube. On the other hand, this is the preferred-type joint to use when brazed connections are employed. In brazing, the clearance between the tube and tube sheet at brazing temperature, for optimum strength and reliability, should be in the range of 0.002–0.006 in. With some metals (aluminum, etc.) joint clearance for brazing may be as high as 0.010 in.

Joint design shown in Fig. 2 provides for an extension of the tube beyond the tube sheet. This would permit depositing a fillet weld at the juncture thus created and therefore would simplify the welding operation. This joint design would be particularly suitable for use with

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[3] Numbers in parentheses refer to the Bibliography at the end of the paper.

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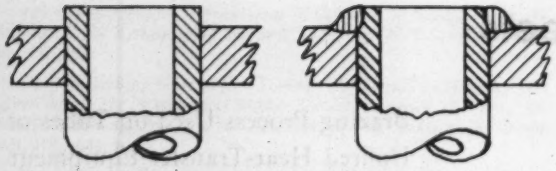

Fig. 2 Joint design with tube projecting beyond the tube sheet. Preparation at left, welded joint at right

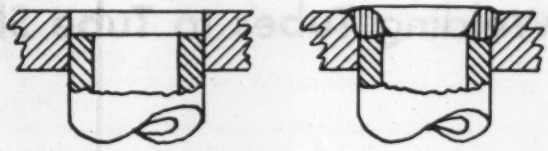

Fig. 3 Joint design with tube recessed into tube sheet. Preparation at left, welded joint at right

Fig. 4 Single-bevel-groove joint design with bevel on tube sheet. Preparation at left, welded joint at right

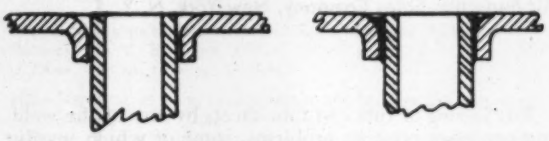

Fig. 5 Stamped sheet-metal joint design for brazed joint. Preparation at left, brazed joint at right

the inert-gas tungsten-arc welding method and metal-arc welding with stick electrodes where the stress conditions could be satisfied with a simple fillet weld. Again great difference in the thickness of tube and tube sheets will create problems of (*a*) securing fusion to the heavier member and (*b*) avoiding burning the thinner member.

Fig. 3 illustrates an assembly of tube to tube sheet in which the tube is recessed from the face of the joint. This type of connection permits depositing a fillet weld at the juncture. It is most suitable for use with metal-arc welding with stick electrodes. Again, it is critical of the relative thickness of the tube to tube sheet, more particularly to avoid burning the thinner member.

The joint shown in Fig. 4 is really a modification of that in Fig. 1, with a bevel provided to permit depositing a full-section single-bevel groove weld. Such a weld would have the advantage of developing the full section of the joint but would be difficult to make in the large numbers encountered in the tube-tube sheet assemblies. It would be best deposited by metal-arc welding with stick electrodes although it might be possible to deposit such joints by the inert gas-tungsten arc process. The bevel can be installed part way down on a heavy tube sheet where it is necessary to provide additional weld metal.

In Fig. 5 a joint particularly suitable for brazing is illustrated. The tube sheet is punched to receive the tube and at the time of punching provides a short lip, the purpose of which is to give the necessary area for brazing filler metal. Joints of this type are reserved almost exclusively for sheet metal.

Processes

The American Welding Society (AWS) in its master chart of "Welding Processes" (2) recognizes eight major processes and a total of 37 subsidiary processes under these major headings. Of this great number only two of the major classifications are of interest here, principally arc welding and brazing. Under the general category of arc welding, the specific processes of shielded metal-arc welding and inert gas-metal arc welding are of interest. Under the general classification of brazing, the specific processes of torch brazing, furnace brazing, and dip brazing are of interest. A welding technique which may be applied by shielded metal arc welding or inert gas-metal arc welding is known as braze welding. This is particularly useful for dissimilar metal combinations.

Shielded metal arc welding with stick electrodes is the common arc-welding process with which everyone is familiar. It requires a source of welding power, either a d-c generator or an a-c transformer. Shielded metal arc electrodes for use with this method are available in a wide variety of analyses ranging from simple carbon steel through low-alloy steels, stainless steels, to copper, aluminum, and nickel alloys. Steel and stainless-steel electrodes are available for welding in all positions (flat, horizontal, vertical, and overhead) while in general, nonferrous electrodes are limited to flat and horizontal welding.

Inert gas-metal arc welding with nonconsumable electrodes sometimes called inert gas-tungsten arc welding (Heliweld process) may be performed with either d-c or a-c welding power sources. Standard d-c generators and rectifiers are generally satisfactory for this type of welding. However, for a-c welding it is generally necessary to employ transformers specifically designed for this process.

While inert gas-tungsten arc welding frequently is performed without filler metal, welding rods generally of the analysis suitable for gas welding are employed where filler metal is necessary. The inert gas used is either helium or argon or a mixture of these two.

An ingenious adaptation of the inert gas-tungsten arc-welding process known as "cone arc welding" (3), has been developed for joining relatively thin, but unequal, tube to tube-sheet assemblies of stainless steels and nickel alloys. The basic setup is a mechanized tungsten-arc unit employing direct current, argon, and a high-frequency oscillator for arc starting. In addition, a magnetic gas nozzle is employed which serves to direct the arc in a conical path. A control circuit is necessary for operation of all features of the process in proper sequence. The arc, once initiated by the high frequency, follows the joint, Fig. 2, rotating around the periphery of the tube in conical fashion. The reaction of the welding current with the magnetic field of the magnetic gas cap results in forces which impart to the arc

its conical path of travel. The arc thus moving fuses the tube to the tube sheet.

Brazing

Another of the fundamental welding processes used in this class of work is brazing, defined as "a group of welding processes wherein coalescence is produced by heating to suitable temperatures above 800 F and by using a nonferrous filler metal having a melting point below that of the base metals. The filler metal is distributed between the closely fitted surfaces of the joint by capillary attraction" (4).

For the fabrication of heat exchangers three methods of brazing are in common use, viz., torch brazing, furnace brazing, and dip brazing. Brazing filler metals are covered by the recently issued Tentative Specifications for Brazing Filler Metal, AWS designation A5.8–52T, ASTM designation B260–52T (5). This specification provides for 7 groups of brazing filler metal as follows: aluminum-silicon, copper-phosphorus, silver, copper-gold, copper, and copper-zinc, magnesium and heat-resisting materials.

Torch Brazing. Torch brazing is the familiar form in which the heat for brazing is secured from a torch flame. This may be an oxyacetylene flame, or one derived from the combustion of other fuel gases with oxygen or air.

Torch brazing is very flexible and particularly useful where members of different thicknesses or masses must be brazed since under such conditions the torch permits distributing the heat in such a manner that all elements can be brought to brazing temperature uniformly without overheating.

Furnace Brazing. Furnace brazing is that method which derives the heat for brazing from a furnace which may be either gas-fired or electrically heated, with or without a controlled atmosphere. The operating temperature for the furnace is dictated by base metal to be joined and the filler metal employed. With certain combinations of base metal and filler metal it is possible to use a controlled atmosphere in the furnace in which case brazing fluxes generally may be omitted. Since furnace brazing involves heating of the entire assembly, care must be exercised to avoid overheating of lighter members. However, since furnaces are operated continuously, they are suitable for production work.

Dip Brazing. Dip brazing is another brazing technique which in actual principle involves two distinct techniques. One of these, molten filler-metal-bath dip brazing is of little interest in the present instance; therefore consideration will be given only to molten flux-bath dip brazing (5). In this procedure a container, usually metal or ceramic, and of a size adequate to accept the parts to be brazed, is charged with dry-powder brazing flux and this flux is first reduced to the molten state. While heating of these flux baths will be by any of the accepted means, the most common method is to employ electrical heating using the I^2R loss through the flux for heating.

The parts to be brazed, with brazing filler metal preplaced, are immersed in the molten flux bath. Preheating before immersion in the molten flux bath is generally necessary; it is essential on large assemblies, or those involving units of greatly differing masses. It is also necessary when extensive jigs are used to align the parts. Brazing is accomplished substantially over the entire assembly upon immersion in the molten flux and the time to accomplish a braze ranges from a few seconds to 4 or 5 min. Dip brazing is well-suited to production operations and particularly to the fabrication of certain classes of heat exchangers, notably those fabricated of aluminum and aluminum alloys.

Braze Welding. Braze welding is a method of joining similar and dissimilar metals that is related both to the conventional welding and the brazing processes. By definition braze welding is "a method of welding whereby a groove, fillet, plug, or slot weld is made using a nonferrous filler metal, having a melting point below that of the base metal but above 800 F. The filler metal is not distributed in the joint by capillary attraction. Bronze welding, formerly used, is a misnomer for this term" (4).

Braze welding is a method of welding which may be applied by metal-arc, inert gas-tungsten arc, or as it is most frequently performed, by oxyacetylene welding. In the case of heat exchangers, metal-arc welding with stick electrodes and inert gas-tungsten arc welding are most frequently employed. Since braze welding does not involve melting of the base metal, and the nonferrous filler metal melts at relatively low temperatures, it follows that the method is particularly well-suited for joining similar metals of greatly varying thicknesses or for the joining of dissimilar metal combinations.

Metals

The most significant factor, aside from the fundamental design considerations of the heat exchanger, is the metal or metals of which the tube and tube sheets are made together with the relative thicknesses. Since the metals used in the assemblies may be similar or dissimilar, i.e., the tubes may be of the same or different composition from the tube sheet, the chart in Fig. 6 has been prepared to show these combinations. In the individual boxes of the chart are listed the welding processes suitable for the combinations indicated. The order of recording the processes in these boxes is roughly the order of preference for their use. The following discussions will be based upon the metal combinations and the processes indicated in the chart, Fig. 6.

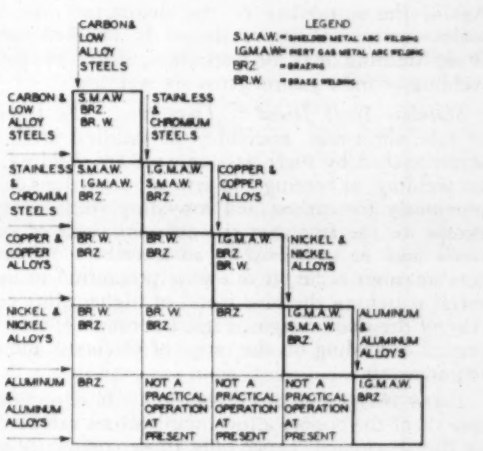

Fig. 6 Chart showing welding methods for various combinations of tubes and tube sheets

Obviously, the simplest combination is for tube and tube sheet to be of similar metals. Thus one of the variables is eliminated and the problem resolves itself into relative thicknesses of the two members. In general, welding by metal-arc welding or inert gas-tungsten arc welding will be found preferable for this type of assembly particularly where the ratio of tube-sheet thickness to tube thickness does not exceed approximately 4 : 1. If greater differences occur then it will be necessary to resort to brazing or braze welding, and this in turn will depend upon whether the particular service conditions will permit the presence of a dissimilar metal, in the form of the filler metal for brazing or braze welding.

Carbon and Low-Alloy Steels Joined to Themselves. The simplest combination of metals is carbon or low-alloy steels in both elements of the assembly. Where the tube and tube-sheet thickness falls within the 4 : 1 ratio metal arc welding is greatly to be preferred. Generally speaking joint designs will be of the types illustrated in Figs. 1, 2, and 4, although the joint in Fig. 3 conceivably might be used under these circumstances.

Within the limitations of available filler metal the welding electrodes should match the composition of the base metals joined. Where exact duplication is not possible then the filler metal preferably should be somewhat higher in alloy content. The necessity for preheating when welding carbon or low-alloy steel assemblies will depend upon (*a*) the relative sizes of the members, (*b*) type of filler metal employed, (*c*) code requirements.

Where dimensions of tube and tube sheet preclude use of welding, then it is advisable to consider the use of brazing. On small assemblies torch brazing of the individual tubes will prove satisfactory although somewhat slower than other techniques. For higher production rates furnace brazing may be employed to achieve substantially over-all brazing of all tubes in one operation. Filler metal may be preplaced or hand-fed for torch brazing but preplacing is essential for furnace brazing. Brazing filler metal suitable for ferrous metals includes the general classification group of BAg, BCu, BCuZn, BNiCr, BAgMn (7).

Braze welding may be used for connections between tube and tube sheets with ferrous metals, employing either stainless-steel filler metal or nonferrous filler metals. Again, the suitability of the dissimilar filler metals under service conditions should be checked carefully. Braze welding may be performed either by metal-arc welding or inert gas-tungsten arc welding.

Stainless Steels Joined to Themselves. The fabrication of tube sheet-tube assemblies of stainless steel can be accomplished by inert gas-tungsten arc welding, metal arc welding, or brazing. In general, conditions described previously for carbon and low-alloy steels apply here except for the fact that the different types of stainless steels may be combined in an assembly. Where such combinations occur, it is a wise precaution to use filler metal matching the base metal of higher alloy content. Any of the joint designs, Figs. 1 through 4, may be employed depending on the range of thickness and service requirements.

Copper Alloys Joined to Themselves. It is obvious that not all of the copper-alloy combinations can be covered in this discussion; hence only those commonly encountered in welded construction will be discussed, viz., deoxidized copper, aluminum bronze, and silicon bronze. For joining tube sheet-tube assemblies of copper or copper alloys, the inert gas-tungsten arc process, brazing, and braze welding may be used. The other copper alloys in general may be handled in a manner similar to that covered here except when zinc or lead are present. The presence of zinc in amounts above 1 per cent will cause difficulty with the inert-gas arc process; such alloys may be brazed or braze-welded. Lead in amounts exceeding 0.5 per cent will cause difficulty with welding, brazing, or braze welding. Further, certain combinations of these alloys are sufficiently different so that conditions border upon dissimilar-metal combinations. Therefore care must be exercised in making combinations of copper alloys. The joint designs, as covered in Figs. 1 through 5, in general, would be applicable subject to the limitations previously enumerated.

Nickel and Nickel Alloys Joined to Themselves. Nickel and nickel alloys for heat-exchanger assemblies are best joined by the inert gas-tungsten arc process. Metal arc welding with covered electrodes is also a possible solution, and brazing offers still further possibility. The alloys to be considered here include nickel, monel, and inconel. Joint designs in general will follow those shown in Figs. 1 through 5.

Aluminum and Aluminum Alloys. The fabrication of heat exchangers of aluminum and aluminum alloy is best accomplished by inert gas-tungsten arc process and brazing. Generally speaking the compositions involved in this class of work would be 2S, 3S, 52S, and 61S. Joint designs as pictured in Figs. 1 through 5 are applicable to these assemblies.

Dissimilar-Metal Combinations. The problems involved in joining similar or substantially similar metals are relatively simple when compared to those encountered in dissimilar-metal combinations such as are frequently encountered in heat-exchanger work. Except for a relatively few combinations welding is not practical and instead it is necessary to resort to brazing or braze welding. There are, of course, many situations in which the conventional mechanical joints are acceptable as are also soft-soldered connections.

Carbon and Low-Alloy Steels to Stainless Steels. Combinations of carbon or low-alloy steels with stainless steels may be joined by metal arc welding, inert gas-tungsten arc, and brazing. For welding operations it is generally advisable to use a filler metal of the stainless-steel type. Further it is also a wise precaution to select a filler metal of higher alloy content than the stainless steel involved to offset any dilution of the stainless-steel deposit by the carbon or low-alloy-steel base metal. If inert gas-tungsten arc welding is used, d-c straight polarity with helium or argon may be employed although argon with a-c and continuous high frequency will be helpful to control oxide removal and permit of shallow penetration. Torch or furnace brazing may be used for this combination of base metals together with filler metals conforming to the general classifications, BAg, BNiCr, and BAgMn (7).

Carbon and Low-Alloy Steels to Copper and Copper Alloys. Because of the wide differences in melting points of copper and steel it is not possible to join this combination by conventional welding methods. Instead, it is necessary to use braze welding applied either by metal arc welding or inert gas-tungsten arc techniques, or brazing. If braze welding is performed with stick electrodes then aluminum-bronze electrodes of classification ECuAl-A

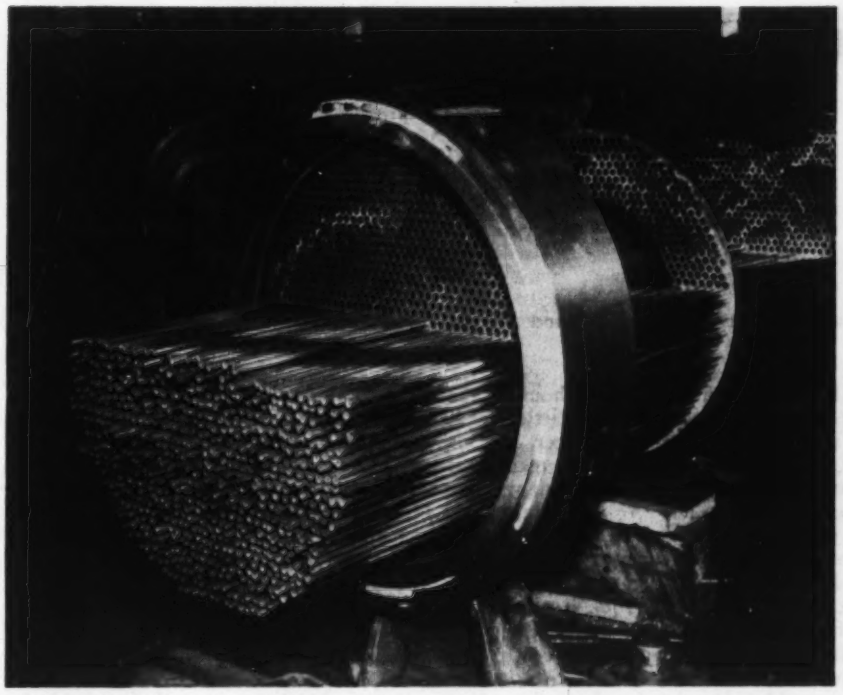

Fig. 7 Assembly of heat exchanger consisting of a 26¾-in-diam by 4-in-thick tube sheet of Type 304L stainless steel and 1270 copper tubes, ⅜ in. in diam by 14 in. gage.

(8) should be used. For braze welding by the inert gas-tungsten arc process filler metals should conform to classification RCuAl-A2 (9). For brazed assemblies filler metal should conform to the general classification BAg of which filler metal of BAg 1, BAg 2, or BAg 3 (7) proves best-suited.

Carbon and Low-Alloy Steels to Nickel and Nickel Alloys. With this combination of base metals conventional welding is again not practicable and instead, braze welding or brazing must be resorted to. Braze welding is performed with stick electrodes. A covered nickel electrode, in general, would be suitable except in the case of inconel; inconel combinations are handled with inconel electrodes. Braze welding with the inert gas-tungsten arc process involves similar filler metals but of course in the bare form. For brazing combinations of this type filler metal should conform to classification BAg 1, BAg 2, BAg 3, or BCuZn-6 (7).

Carbon and Low-Alloy Steel to Aluminum. Generally speaking, joining aluminum to ferrous metals by any welding process is not a successful operation. However, it is possible to employ aluminum brazing to effect a connection which is satisfactory. Such operations are performed on certain domestic-refrigerator parts. The operation is accomplished as a furnace-brazing procedure and a special aluminum brazing flux is applied to both members. Filler metal is generally of the BAlSi-4 classification (7).

Stainless Steel to Copper. For combinations of stainless steel and copper the best joining methods are inert gas-tungsten arc welding applied with the braze-welding techniques and brazing. In braze welding this combination, it has been found that a-c welding power sources equipped with continuous high frequency give the best results. Filler metal should be of the aluminum-bronze type, classifications RCuAl-A1, RCuAl-A2 (8)

Fig. 7 illustrates a complex assembly of 1270 copper tubes into a stainless-steel tube sheet. The tubes are ⅜ in. OD by 14 in. gage. The "tube sheet" is a 26¾-in. diam × 4-in-thick forging of AISI Type 304L stainless steel. The finished assembly had to withstand a hydrostatic test pressure of 4200 psi. The joints were welded with inert gas-tungsten arc welding employing a-c with continuous high frequency and argon. Aluminum bronze filler metal was of classification RCuAl-A1 (9). Joint design conformed to that detailed in Fig. 3. After welding all joints were rolled. The finished assembly successfully withstood test pressures. For brazing this combination, filler metal of classification BAg 1, BAg 2, and BAg 3 (7) will give the best results. Brazing may be performed by torch or furnace-brazing techniques.

Stainless Steel to Nickel and Nickel Alloys. The joints between stainless-steel and nickel and nickel-alloy tube and tube sheets may be made by braze welding with the inert gas-tungsten arc process, metal arc welding or brazing. For the inert gas-tungsten arc process, d-c straight polarity and helium should be used. Filler metal for both these d-c welding processes are substantially the same with covered electrodes being used for metal arc welding and the bare welding rods for the inert gas-tungsten arc process. For stainless steel to nickel, filler metal may be inconel, nickel, or stainless-steel composition; stainless steel to monel may be accomplished with monel or nickel filler metal; stainless to inconel would be performed with inconel, or stainless-steel filler metal. Brazing which may be performed with torch or furnace techniques will require filler metal of BAg 1, BAg 2, BAg 3, or BCuZn-6 (7) classifications.

Copper to Nickel. Assemblies of this combination are best handled by brazing with either the torch or furnace-brazing techniques. Filler metals of the BAg 1, BAg 2, and BAg 3 (7) classifications should be employed.

Other Combinations. It will be observed that there are three dissimilar-metal combinations listed on the chart in Fig. 6, which have not been discussed; they are stainless steel to aluminum, copper to aluminum, and nickel to aluminum. In the present state of the art joining these metal combinations by a welding or brazing process has not proved practicable.

(Continued on page 433)

Air Pollution in a London Smog

Analysis of World's Most Disastrous Smog Incident Causing Four Thousand Fatalities

By E. T. Wilkins[1]

Department of Scientific and Industrial Research, London, England

BETWEEN December 5 and 9, 1952, a belt of fog patches covered many thousands of square miles of the British Isles. In some places the fog remained relatively pure; in others it became polluted by solid, liquid, and gaseous emissions, mainly from industrial and domestic fuel-burning appliances, and thus became smog.

In most of the affected areas the fog or smog appeared no different from that which had occurred on numerous other occasions. In London, however, it soon became evident that the smog was exceptional, for in some localities the visibility fell to a few yards and even inside buildings visibility was so much reduced that some public performances had to be abandoned. Several prize cattle, which were on show in central London, developed respiratory trouble and died. Soon it became evident that mortality and morbidity among the human population were soaring, and by the end of the year about 4000 people had died from the effects of the smog, and a great many more were suffering impairment of health.

Two questions which arise in connection with the medical and other investigations into this incident are: What dangerous impurities were present and in what concentrations?

Under an arrangement between the Department of Scientific and Industrial Research and various local authorities, measurements of pollution are made regularly in various parts of the country including London. Thus results are available for the concentrations of smoke and sulphur dioxide at a number of sites in the affected area, and it is these results which are the basis of the present paper.

There have been other smog incidents, notably those which occurred in 1930, near Liege in Belgium and in 1948 at Donora, Pa., both resulting in loss of life. No direct measurements of pollution were made on those occasions. The present data, therefore, although meager, are believed to be the first to show by direct measurement the pollution changes which occurred during a serious smog incident.

London's Pollution

An important factor in Britain's smoke problem, and London's in particular, is the open-fire burning of bituminous coal, which is the main form of heating used in homes. Out of a total annual coal consumption of a little over 200 million tons, about 37.5 million tons, or 18 per cent, is used directly for domestic purposes; the remainder is applied to various industrial and other uses. But whereas the efficiency of the combustion of coal by industry has been steadily improved, the domestic fire has not improved to anything like the same extent; in consequence, each ton of coal burned domestically at the present time produces on the average two or more times as much smoke as each ton burned by industry. In Greater London about 120,000 tons of smoke pour each year from some 3,000,000 domestic chimneys scattered over its area.

The significance of the domestic pollution is made greater because it occurs almost entirely in the winter months and is at a maximum at the time when fogs are most prone to occur. On account of this seasonal variation, it is estimated that over the country as a whole the smoke contributed by domestic fires represents about 60 per cent of the total in winter; in London the proportion may be even higher. It happens that the amount of coal used domestically in the whole country is approximately equal to that used for the generation of electricity, but whereas the average height of the domestic chimney is of the order of 30 to 40 ft, the height of most modern power-station chimneys is ten times greater. When very large emissions of sulphur gases from tall chimneys descend to ground level they may give rise to appreciable local concentrations of sulphur dioxide, but, in general, the proportion of the total which reaches ground level from such a chimney is much less than that from the lower chimneys.

The same difference occurs with carbon monoxide which, in towns, is produced in much larger quantities by domestic open fires than by the automobiles which congest the streets. Owing, however, to the greater height of the discharge and lower concentration of carbon monoxide in the gases from domestic chimneys, its toxic effects near ground level are likely to be less than those of automobile exhausts.

Meteorological Conditions

The December 5, 1952, incident commenced in London with the arrival, in the early hours, of an anticyclone from the Northwest. There was then an almost complete calm with an inversion of the normal temperature lapse rate which, by decreasing the natural turbulence of the air, prevented the dissipation of the ground-level pollution into the upper atmosphere.

Temperatures fell to about the freezing point and the

[1] Officer in Charge, Atmospheric Pollution Research, Fuel Research Station.

Contributed by the Committee on Air Pollution Controls and presented at a Joint Session of the Committee on Air Pollution Controls and Fuels and Power Divisions and presented at the Annual Meeting, New York, N. Y., November 29–December 4, 1953, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

fog became patchy but widespread with very low visibility in places. The main area affected was the valley through which the river Thames flows in a generally eastward direction. Central London lies at the bottom of the basin with the rest of the built-up area spreading along the valley and up the gently rising ground to the north and south of the river. During the incident this valley was filled with fog or smog to a width of about 20 miles or more and to a greater distance along the valley in each direction. The depth of the fog bank appears to have been variable between about 150 and 400 ft, with some hilltops and high landmarks (including some power-station chimneys) protruding through the fog into the haze above.

Smoke and Sulphur-Dioxide Concentrations

Method. The methods of measurement employed in this investigation were those generally used in Britain, which have been described previously in detail.[2] Briefly, the procedure was to aspirate a measured quantity of air, first through a filter paper and then through a dilute solution of hydrogen peroxide. The coloration produced by the smoke deposit on the paper was estimated by a photoelectric reflectometer and the result converted to a weight basis by means of a previous calibration. The total acidity (excluding carbon dioxide) of the hydrogen-peroxide solution was determined by titration and assumed to be due solely to sulphur dioxide.

A total of 12 test sites provided daily results; 6 were confined to a riverside belt 10 miles long and 2 miles wide within the central London area; the other 6 were located at distances up to 5 miles from the river and between 5 and 15 miles from the center of London.

Results. In the central area the maximum recorded concentrations of smoke and sulphur dioxide at each site were between about 5 and 10 times the averages at those sites for a normal December (1951). The highest readings were made at the London County Council Offices in the vicinity of Westminster Bridge (near the Houses of Parliament and Westminster Abbey) where the smoke concentration reached 4.5 mg per cu meter and the sulphur dioxide 1.3 ppm.

In the outer area the maximum recorded concentrations of smoke were between 2 and 5 times the normal values and the sulphur dioxide between 2 and 7 times.

The average concentrations for all sites during the whole smog period, compared with normal, are shown in Table 1.

The observed increase in the smoke concentration above normal (between 3.4 and 6.6 times) is perhaps less than many Londoners who experienced the incident would have expected. It has, however, been pointed out elsewhere[3] that the low visibility during the smog was due primarily to the large number and small size of the constituent water droplets and that the direct effect of the pollution on visibility was probably small. The grime tended to settle more rapidly than usual, making a very conspicuous deposit.

Day-to-day averages of the smoke and sulphur-dioxide concentrations at the 12 sites are shown in the two lower curves of Fig. 1. The first increases occurred in the 24-hr period from noon, December 4, to noon, December 5, and appear on the graph at the center of this period. Since the fog arrived after this period had commenced, the initial rates of increase of concentration may have been greater than that shown, but this is not certain because some increase of pollution may have occurred before the fog actually formed.

The approximate parallelism between the smoke and sulphur-dioxide concentrations is commonly noted in the air-pollution records.

Table 1 Average Smoke and Sulphur-Dioxide Concentrations During Smog and Normal Periods

	Smog period (Dec. 5–9, 1952)	Normal (Dec., 1951)	Smog-pollution ratio
Smoke			
Central area[a]	2.3 mg/m³	0.35 mg/m³	6.6
Outer area[a]	0.75 mg/m³	0.22 mg/m³	3.4
Sulphur dioxide			
Central area[a]	0.73 ppm	0.16 ppm	4.6
Outer area[a]	0.35 ppm	0.08 ppm	4.4

[a] Averages of 6 sites.

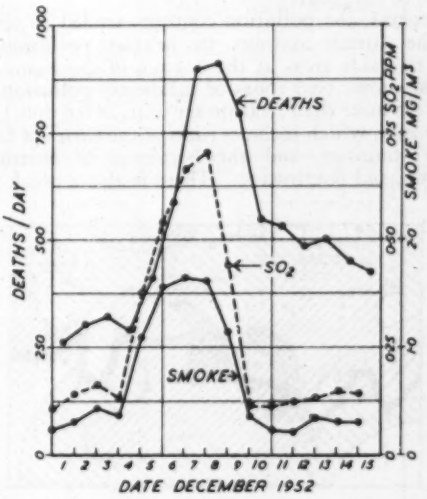

Fig. 1 Daily air pollution and deaths

Pattern of Pollution

Variations in pollution occurred over quite short distances, particularly in the central area. Since there were also variations in mortality in adjacent boroughs, it becomes very desirable to know more about the pattern of pollution.

An attempt has been made to use for this purpose the monthly results from about 120 instruments which were in use at that time to determine sulphur dioxide by the lead-peroxide method. Details of this method have been previously described,[2] and it need only be said here that it gives a mean result in arbitrary units for the amount of lead sulphate formed on a standard surface of lead peroxide exposed to the free air.

During December, 1952, the total amount of sulphur dioxide registered by each of these instruments averaged

[2] "Air Pollution," Proceedings of the U. S. Technical Conference on Air Pollution, McGraw-Hill Book Company Inc., 1952, p. 531.

[3] "London Fog of December 5–8, 1952," by C. K. M. Douglas and K. H. Stewart, *The Meteorological Magazine*, vol. 82, 1953, p. 67.

about twice that of December, 1951, which is considered to be a normal year.

Fig. 2 shows a map of about 135 square miles of the London area, roughly bisected by the river Thames, with shaded contours showing the calculated sulphur-dioxide pollution. The concentrations are expressed in the usual arbitrary units (milligrams of sulphur trioxide per 100 sq cm of exposed surface per day); a factor of 0.04 converts these units very approximately into sulphur-dioxide concentrations in parts per million. Thus the most heavily shaded areas represent roughly the localities where the average concentration for the smog period was above 0.6 ppm.

In general, the pollution contours tended to coincide with the altitude contours, the heaviest pollution lying in the riverside areas at the bottom of the basin. The diagram shows two zones of maximum pollution (concentration more than 15 arbitrary units or 0.6 ppm) in the central area, which includes parts of the Cities of London and Westminster, and the boroughs of Kensington, Lambeth, and Southwark. There is also a break in the

Fig. 2 Approximate pattern of pollution by sulphur dioxide

heavily polluted riverside belt to the right of the diagram at Greenwich and Poplar, probably due to the topography of the district.

It is interesting to note that many areas in which there was an increased mortality the sulphur-dioxide concentration appears to have averaged only about 0.2 to 0.6 ppm. The probable safe concentration of sulphur dioxide for an 8-hr exposure by healthy subjects is 10 ppm.

Other Pollutants

No direct measurements were made other than those already mentioned, but, assuming a carbon-monoxide concentration of 34 ppm in London on a typical winter day[4] and applying a smog-increase ratio of 6, it appears that values of 0.02 per cent may have been reached; in localities where the smog caused abnormal congestion of automobile traffic the concentration may have been higher.

The maximum allowable concentration of carbon monoxide for an 8-hr exposure is about 0.01 per cent.

Estimates of carbon-dioxide concentrations calculated by the foregoing method, and also from the normal approximate ratios of carbon dioxide and sulphur dioxide, indicate concentrations during the smog of between 0.2 and 0.5 per cent.

Concentrations of 0.5 per cent of carbon dioxide in the air is said to cause the breathing to be a little deeper and a little faster than does pure air.

The presence of abnormal concentrations of sulphuric-acid mist during London fog has been previously noted. The abnormal oiliness of the deposited grime was noted by many observers.

Mortality

Fog and smog occurred in many parts of the country, but in 160 large towns (excluding London) with an aggregate population of 14,000,000, it caused no great increase in mortality. In Greater London, however, there were about 4000 additional recorded deaths by the end of the year[5] and possibly some more subsequently.

The smog affected persons of all ages but particularly children and adults over 45 years of age; the increased deaths were mainly ascribed to bronchitis and pneumonia, which increased eight times and three times, respectively.

Some striking features of the incident are shown in Fig. 1 which shows the daily number of deaths in Greater London during the first half of December, 1952, and, on the same time scale, the daily variations in the average smoke and sulphur-dioxide concentrations at the 12 London sites previously referred to. The diagram shows that there was less than 1 day's time lag between the arrival of the smog and the commencement of the increased mortality. During the 3 or 4 days when the general level of pollution was increasing, the number of deaths increased in like manner. When the pollution decreased during December 8 and 9, the number of deaths took a similar downward trend. The death rate did not return to normal until at least 3 weeks from the end of the fog.

On at least four previous occasions during the past 80 years there have been smog incidents in London which were responsible for an increased mortality, but none of these caused so many deaths as did the more recent incident. A few pollution data are available for one of these earlier smogs, which lasted for several days in 1948 and caused deaths in the County of London amounting to about 12 per cent of the number caused by the 1952 incident in the same area. The pollution records show that the maximum smoke and sulphur-dioxide concentrations at one Central London site at which comparable measurements were made amounted, in 1948, to 53 per cent and 46 per cent, respectively, of the 1952 values. Thus a twofold increase in the maximum concentrations of pollution was accompanied by an eightfold increase in the number of deaths.

Acknowledgment

The investigation described in this paper has been carried out as part of the program of the Atmospheric Pollution Research Committee of the Fuel Research Board of the Department of Scientific and Industrial Research, London, England. This paper is published by permission of the Director of Fuel Research. The illustrations are Crown Copyright and are reproduced by permission of the Controller of H. M. Stationery Office.

[4] "Motor Fumes and Atmospheric Pollution," by C. J. Regan, *Chemistry and Industry*, vol. 51, no. 29, 1932, p. 605.

[5] "Mortality in the London Fog Incident, 1952," by W. P. D. Logan, *The Lancet*, vol. 264, 1952, p. 336.

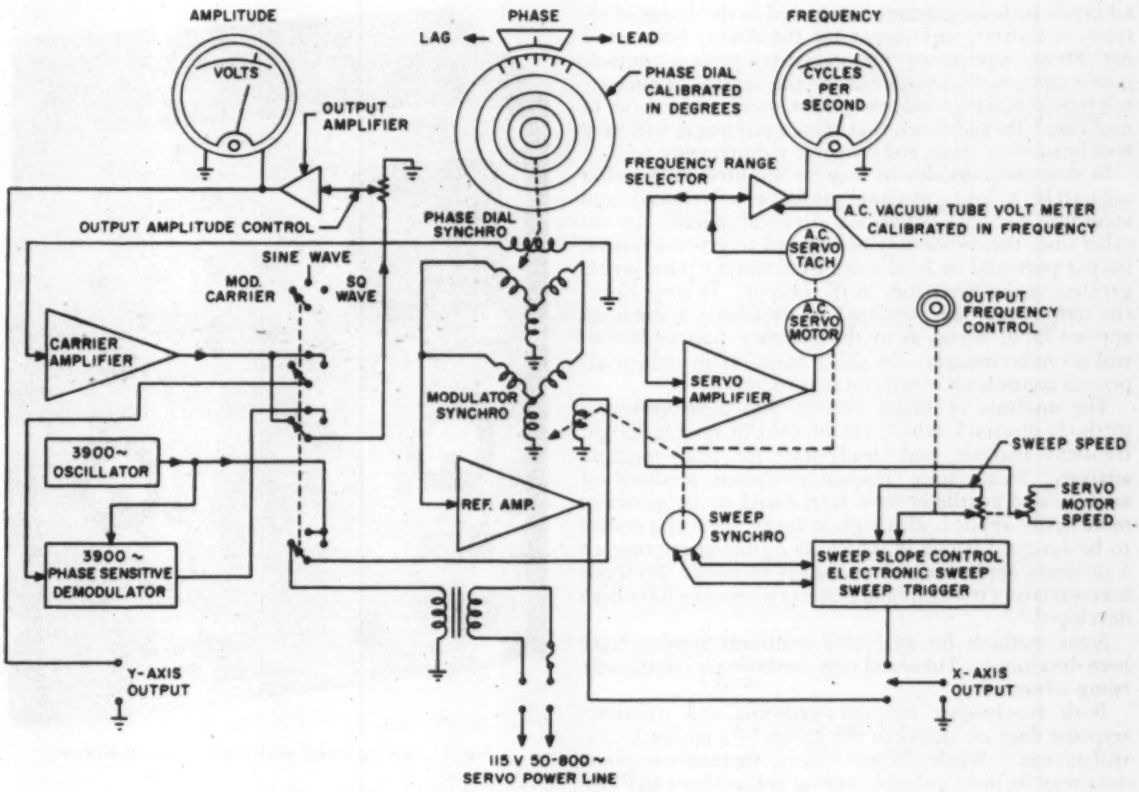

Fig. 1 Simplified block diagram of servoanalyzer

Evaluating Dynamic Performance of Feedback Control Systems

Test equipment arranged and packaged as one convenient instrument is used to determine performance of feedback-control systems or servomechanisms

By T. A. Westover

Servo Corporation of America, New Hyde Park, N. Y.

PERFORMANCE evaluation of a feedback control system usually consists of testing this system under simulated or actual operating conditions.

The term "feedback control system" includes a large class of devices, such as regulators, governors, process controls, positioning servomechanisms, and so on. Explicitly, a feedback control system is a control system which tends to maintain relationship of one system variable to another by comparing functions of these variables and using the difference as a means of control.[1] It can be seen, as just mentioned, that there are an unlimited number of different systems and devices which are properly classified as feedback-control systems. The general field of feedback-control-system engineering can be applied to almost every known science and industry.

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Feedback-Control-System Engineering

The fundamentals of feedback control system engineering have been utilized in solving control problems of

[1] Definition proposed by AIEE Subcommittee on Terminology and Nomenclature of the Feedback Control Systems Committee.

all types, including those encountered in the design of all types of military equipment for the Army, Navy, and Air Force, equipment for industrial process control, power equipment, equipment for the control of nuclear-reaction processes, and equipment used in the field of medicine. It can be seen that these equipments will vary widely in their static and dynamic requirements.

In one case, the device may be required to position accurately a load, machine tool, or antiaircraft gun according to some prescribed electrical signal. In another case, the device may be required to give a constant output potential or hold some fixed output position regardless of the variations in the output. In some cases, the output may be permitted to overshoot a suddenly applied input signal as in the ordinary positional-control servomechanism. In other cases, as in industrial-process control, no overshoot is permissible.

The analysis of linear systems has developed two methods of attack which can be used in system design: transient analysis, and steady-state frequency-response analysis. Steady-state frequency-response methods of analysis and synthesis have been found to be generally more easily applied, although in many cases, the system to be designed is one in which an optimum response to a suddenly applied signal or load is required. Methods for correlating transient and frequency response have been developed.[2,3]

Some methods for analyzing nonlinear systems have been developed. These and new methods are continually being advanced.

Both steady-state frequency-response and transient-response data are useful in the design of a feedback control system. While, in most cases, frequency-response data may be more valuable during the analysis and synthesis work, transient-response data ultimately may be required for performance evaluation.

It is the purpose of this paper to describe methods and equipment useful in obtaining frequency-response and transient-response data.

Test Equipment

Equipment required for measurement of frequency response includes sine-wave signal generator with means of advancing the phase angle of this signal with respect to a time base or reference signal, also provided, and a cathode-ray oscillograph. Means of obtaining closed-loop and open-loop measurements have been described by Brown and Campbell.[2]

Equipment for measuring transient response includes a square-wave signal generator, a saw-tooth or linear sweep-signal generator, a cathode-ray oscillograph. Transient measurements also may be made by means of a recording oscillograph in which case the motion of the paper or film is controlled to provide the time base.

Most of the necessary requirements for servomechanism testing may be provided by one instrument which is a combined signal generator, calibrated signal phase shifter, and cathode-ray indicator. A simplified block diagram of this instrument is shown in Fig. 1. Physical configuration is shown in Fig. 2.

The instrument contains two synchros with their stator windings connected together in the conventional

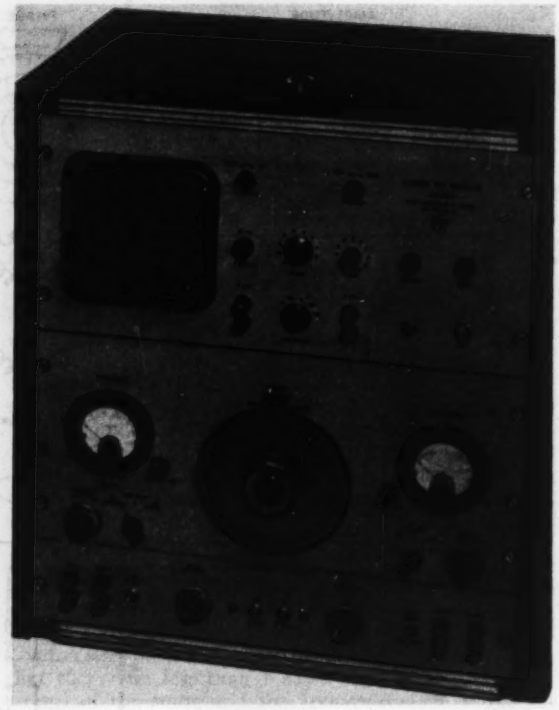

Fig. 2 Servoanalyzer with cathode-ray indicator

manner. The rotor of one synchro is driven by a variable-speed drive, consisting of a servoamplifier, servomotor, and tachometer generator. The rotor of the driven synchro is excited externally from the servopower line for use with testing a-c control systems and from an internal 4000-cycle oscillator for generating low-frequency signals for testing d-c control systems.

Attached to the shaft of the rotating synchro is a synchronizing switch used to trigger a saw-tooth signal generator.

The modulation signal frequency may be varied over a range of 200 to 1 (0.1 to 20 cps or 0.15 to 30 cps) by controlling the speed of the velocity servo through an input potentiometer. Another potentiometer on the same shaft is used to control the time constant of the electronic sweep circuits.

Thus the instrument generates synchronously two signals, a sinusoidally modulated suppressed carrier signal and also a saw-tooth signal whose amplitude is constant and whose period is equal to 1 cycle of the modulated signal. However, by means of the phase dial synchro the envelope of modulating signal may be made to lag or lead in phase or time the saw-tooth signal.

Test Methods, Frequency Response

Frequency-response measurements are made in the following manner:

With the equipment connected as shown in Fig. 3, the amplitude of the input signal under test is set at a value which will not cause saturation in the servoamplifier due to the maximum anticipated error signal in the servoamplifier, or in the motor by requiring velocities and

[2] "Principle of Servomechanism," by G. S. Brown and D. P. Campbell, John Wiley & Sons, Inc., New York, N. Y., 1948.

[3] "Servomechanism and Regulating System Design," by H. Chestnut and R. W. Mayer, John Wiley & Sons, Inc., New York, N. Y., 1951.

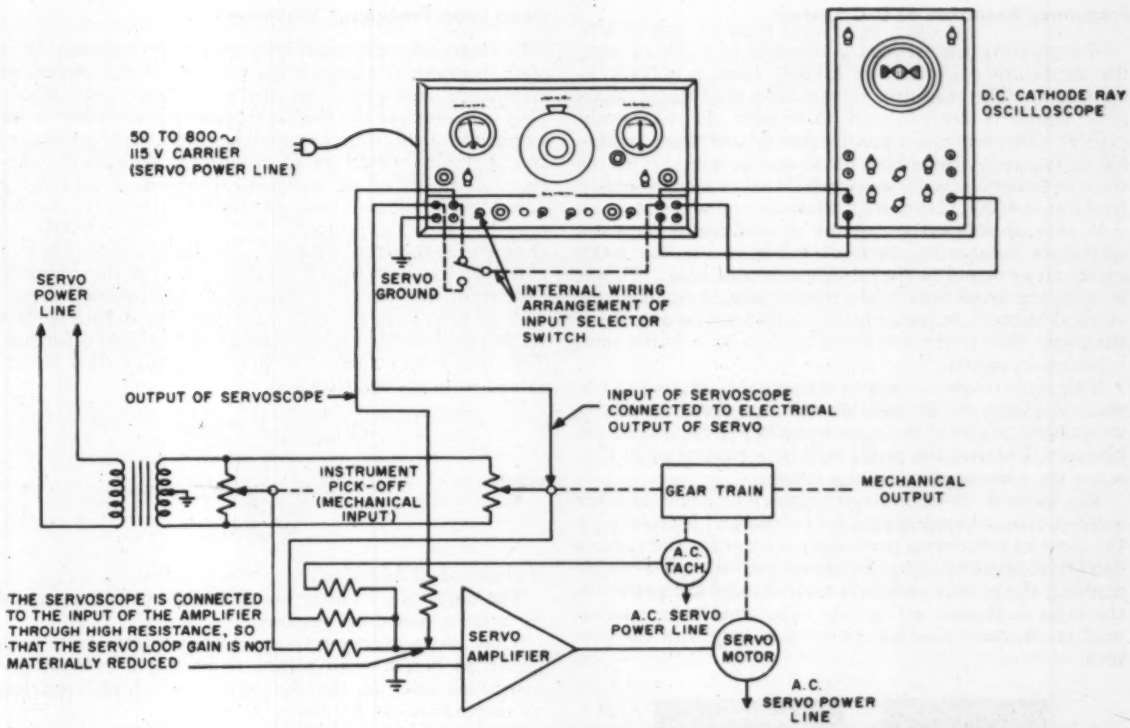

Fig. 3 Test arrangement

accelerations of the motor shaft which the motor is incapable of delivering.

The frequency of the input signal to the system is set at a low value compared to the resonant frequency of the servosystem and the presentation on the scope is adjusted to a convenient magnitude on the cross-hatched scale of the oscilloscope. At this frequency, negligible difference between input and output will be exhibited by the servo under test, both in amplitude or phase. Therefore the output signal from the servo under test will be essentially in phase with the sweep signal and the presentation on the scope will look like Fig. 4A.

As the sinusoidal forcing frequency is increased, however, the servo under test will show a lag which is manifest by its output being late with respect to the sweep signal and the presentation on the scope will look like Fig. 4B. By rotating the rotor shaft of the stationary synchro the pattern may be adjusted until it is again in step with sweep signal, and the presentation will again look like Fig. 4A. This is accomplished by causing the input signal to the servo being tested to lead the sweep signal an amount sufficient to compensate for the lag taking place in the servo. The amount of lag may be read directly on the dial of the stationary synchro.

Readings of phase are similarly taken for other values of frequency in convenient steps over the entire frequency range of interest. Amplitude measurements are made at the same time by observing the vertical height of the envelope on the cathode-ray oscilloscope.

Another method of measuring phase angle also is provided in this instrument. Instead of applying the sawtooth voltage signal to the horizontal channel of the cathode-ray tube, a reference signal from the stator of the rotating synchro may be used. Thus, in this method of test, the cathode-ray tube has applied to its vertical deflection plates the sinusoidally modulated suppressed carrier signal from the servo under test, and to its horizontal deflection plates, a reference signal which is likewise a sinusoidally modulated suppressed carrier signal. When the envelopes of the two carrier signals are in phase the resulting signal is a straight line as shown in Fig. 5A. However, when the envelopes are not in phase, the result is a rosette. The pattern for 90-deg phase shift is shown in Fig. 5B. In measuring phase angle with this method the procedure is to rotate the phase dial synchro until the pattern is again as shown in Fig. 5A. As before, the phase shift of the servo system under test is read on the phase dial. Amplitude of the output is obtained by measuring the vertical height of the rosette.

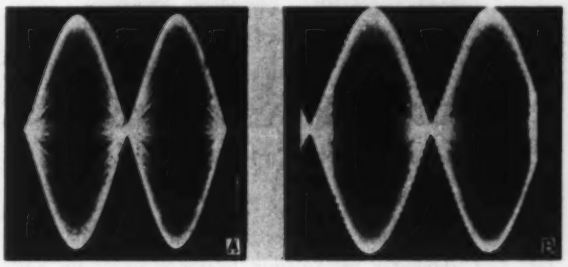

Fig. 4 Cathode-ray presentation of servo output

Frequency Response of D-C System

In measuring the frequency response of a d-c system, the modulating synchro is excited from a 4000-cycle oscillator. The resulting sinusoidally modulated 4000-cycle signal is demodulated to remove the 4000-cycle carrier. The result is a low-frequency sine wave, variable in frequency, and whose phase may be varied with respect to either a saw-tooth sweep signal or a sinusoidally modulated 4000-cycle carrier reference signal.

In making frequency-response measurements on a d-c system or component, it is desirable to use the 4000-cycle carrier signal as the reference or time base. This is because the usual drift in the direct-coupled oscilloscope vertical channel amplifier makes it difficult to determine the phase shift of the sine wave with respect to the saw-tooth sweep signal.

If the low-frequency sine-wave signal is applied to the vertical plates of the oscilloscope and the sinusoidally modulated carrier of the same frequency is applied to the horizontal plates, the result will be a pattern as in Fig. 6, for the various phase angles shown.

The method for obtaining frequency-response data for a direct-coupled system or a d-c component is essentially the same as mentioned previously, except for the pattern displayed on the scope. In obtaining each phase-angle reading, the phase synchro is rotated until the pattern is the same as shown in Fig. 6A. The amplitude is measured at the same time by the vertical height of the pattern.

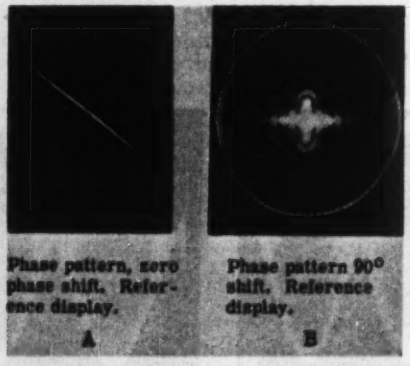

Fig. 5 Cathode-ray presentation reference signal on horizontal plates

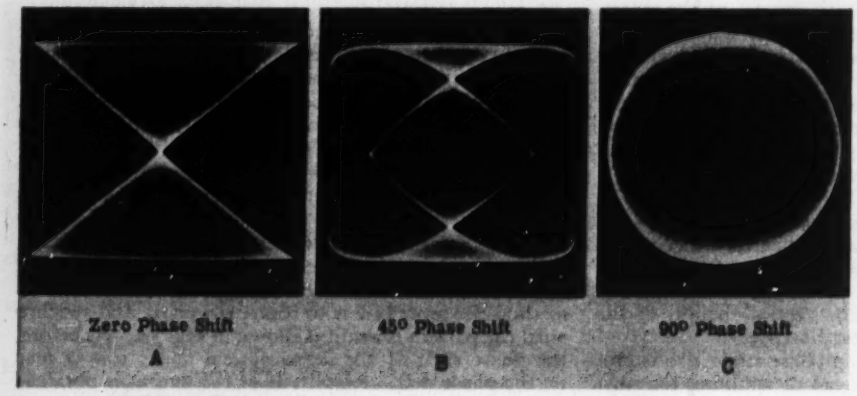

Fig. 6 Cathode-ray presentation sine wave versus 4000-cycle reference

Open-Loop Frequency Response

In measuring the open-loop frequency response it is often desirable to compare the velocity of the output, in magnitude and phase, to the actuating signal $E(j\omega)$. This is because at the lowest frequency measurement the amplitude of the output approaches infinity theoretically, and therefore would be in magnitude beyond the mechanical limits of the mechanical system or measuring device. The measurement of the velocity of the output may be facilitated conveniently by a small electric tachometer of the drag-cup type. The inertia of the rotor of this device is very small compared to that of the mechanical output transducer. Furthermore, it frequently is possible to place it in the gear train or on the output so that its inertia reflected on the transducer is reduced further. The open-loop transfer function $G(j\omega)$ may then be obtained from the relationship

$$G(j\omega) = \frac{1}{j\omega} \frac{\omega_0(j\omega)}{E(j\omega)}$$

where

$$\frac{\omega_0(j\omega)}{E(j\omega)}$$

is obtained as described.

The open-loop transfer function also may be obtained from the closed-loop response.[4]

Thus far frequency-response measurements have been presented herein with regard to electrical systems primarily because of the flexibility by which electrical measurements can be made.

Mechanical-System Measurements

In frequency-response measurements of an all-mechanical system some means of applying a mechanical input is required as, for instance, in the case of a hydraulic system where the input must be applied to a pilot valve. This may be handled conveniently by means of an electromechanical transducer. The transducer may be a solenoid, or position-control device whose frequency response has been determined, or which, in any case, may be found conveniently in the manner which has been described previously. For mechanical outputs there are many devices which may be used to convert the mechanical output into any electrical signal whose response is linear and, for the most part, independent of frequency, such as potentiometers, synchros, strain gages, and the like.

The frequency response of any mechanical system or component may be found by using the equipment previously described and the necessary electromechanical transducers. If the response of the electromechanical transducers, added to the mechanical system for measurements, is an appreciable part of the over-all response, then it must be taken into account in obtaining the fre-

[4] Reference 2, p. 322.

quency response of the mechanical system. This is done easily with methods established by steady-state frequency analysis.

Transient-Response Test Methods

For obtaining transient-response information a square-wave signal is generated by the servoanalyzer and this wave also is supplied in synchronism with the saw-tooth sweep-signal voltage.

If the square-wave signal is applied to a d-c system and the output of the system is applied to the vertical plates, the result is shown by Fig. 7, depending upon the damping factor (ζ) of the device under test. Quantities of interest related to the transient performance of the system may be determined from this type presentation.

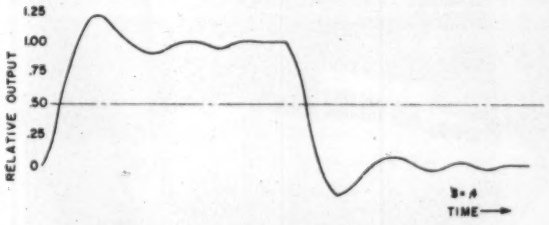

Fig. 7 Response of d-c system to square wave

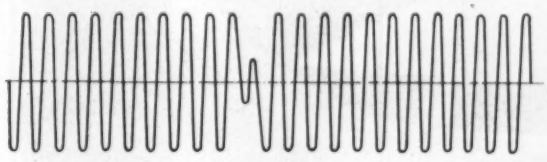

Fig. 8 Modulated square-wave signal

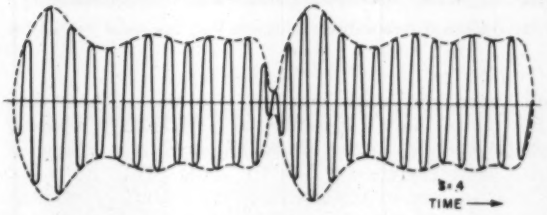

Fig. 9 Response of a-c system to square wave

These quantities include the overshoot, response time, rise time, settling time, and possibly dead time.

Transient-response measurements for a-c systems may be measured conveniently in a similar manner. This is done by energizing the coil of a double-pole double-throw relay by the d-c square wave from the servo-analyzer. Compensation for the time delay in the relay can be facilitated by rotating the phase-dial synchro, and the square-wave-modulated a-c signal can be synchronized with the saw-tooth sweep. The presentation on the cathode-ray tube will look like Fig. 8.

When the output of the relay is applied to the vertical plates and the saw-tooth sweep to the horizontal plates, the presentation of the output of an a-c servosystem or component will look like Fig. 9 for one particular condition of damping shown, as an example.

Welding Tubes to Tube Sheets

(*Continued from page 425*)

Conclusion

The assembly of heat-exchanger components by welding is desirable in order to achieve the advantage of welded construction. However, it requires careful consideration of the factors involved, i.e., design, material, and workmanship, if a satisfactory product is to be secured. This discussion has been largely confined to applications and techniques which are known to be in use. Some of the newer welding techniques offer possibilities in this field which merit further investigation.

One of these new processes is inert gas-metal arc welding with consumable electrode wire (Aircomatic process). In this, a filler metal in wire form is fed continuously through a hand-operated gun. Welding current, usually d-c reversed polarity, is applied to the wire near the arc. The inert gas is helium or argon or a mixture of the two; under some conditions other gases, e.g., oxygen, are added in small quantities. Current densities are high, as are also the wire-feed speeds. The combination of high wire-feed speeds and high current densities creates an arc that is self-regulating and capable of high deposition rates. Another feature of the process is to preserve the analysis of the filler wire in the transfer across the arc. There is a minimum of loss of alloying ingredients.

Therefore this process offers possibilities in welding the alloys and the dissimilar-metal combinations encountered in heat-exchanger work.

Acknowledgments

The authors wish to acknowledge, gratefully, the assistance and co-operation of Mr. S. Kopp, Alco products division of American Locomotive Company, Dunkirk, N. Y., in securing the data and illustrations on the fabrication of the exchanger involving the heavy stainless-steel tube sheet and copper tubes. Acknowledgment is also made to Mr. J. J. Fischer, chief engineer, Process Equipment Division, Patterson-Kelley Company, Inc., East Stroudsburg, Pa., for the design and production data on welded and brazed heat exchangers.

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Briefing the Record

Abstracts and Comments Based on Current Periodicals and Events

J. J. Jaklitsch, Jr., Associate Editor

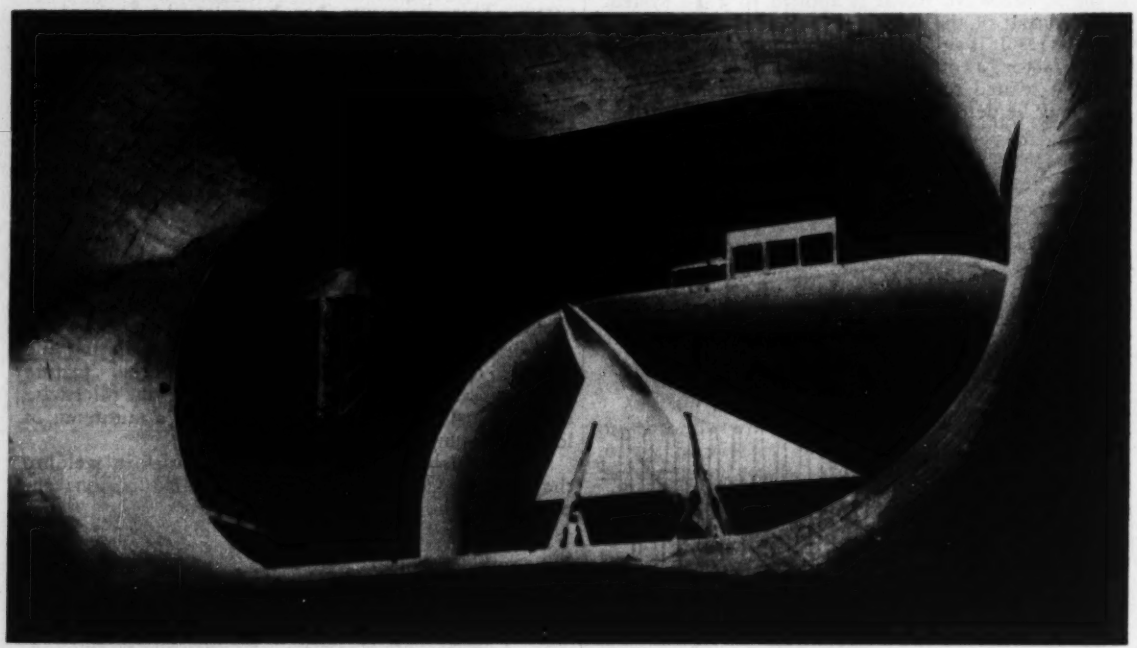


Fig. 1 View of a model in the full-scale wind tunnel at Langley Aeronautical Laboratory, Langley, Va., operated by NACA

U. S. Wind Tunnel Industry

THE wind tunnel is the foundation of every vehicle of flight. This has been so to date and it will become more so in the future, according to an article in the *Westinghouse Engineer*, March, 1954, prepared by C. A. Scarlott, editor of the magazine. The rapid rise in speed of airplanes, the crossing of the sonic region, new types of power plants, rockets, and guided missiles have created a mass of complex, interrelated problems far beyond any prospect of solution via known data. This has led to a vast specialization of wind tunnels and a great spread in their numbers, physical locations, sizes, air speeds, operating conditions, and functions.

There are about 200 wind tunnels in the United States. They range in size of test section from a few square inches to the 40 × 80-ft giant at Ames Laboratory in California, and in power from $1^1/_2$ hp up to 216,000 hp—not yet completed for Arnold Engineering Development Center at Tullahoma, Tenn. Velocities range from less than 100 mph to about 10,000 mph that can be maintained in a 1 × 4-in. section for a few milliseconds at the Cornell Aeronautical Laboratory at Buffalo, N. Y.

Some 17 of the nation's universities have about 30 wind tunnels, almost evenly divided between subsonic and supersonic, with but one transonic. These subsonic tunnels have test sections as large as 12 ft, with air speeds generally in the 125 to 300-mph class, and with drive horsepowers of 250 to about 2500 hp. The scholastic supersonic tunnels have sections as small as 1 × 4 in. and as large as 17 × 20 in., with a span of Mach numbers from 1.3 to about 5.

University tunnels serve two important functions—classroom instruction and research work.

Privately Owned Tunnels

Most airframe and engine builders have at least one tunnel—usually subsonic—with test sections up to 10 or 12 ft. The outstanding example of a privately owned facility is the Edmund T. Allen Memorial Laboratory of the Boeing Airplane Company, Seattle, Wash. Their original tunnel was built in 1944 and was powered by an 18,000-hp synchronous motor and eddy-current clutch. It has recently undergone extensive reconstruction consisting, in part, of the addition of a 36,000-hp induction motor, making 54,000 hp in all, and changes in the 8 × 12-ft test section. Speeds up to Mach 1.2 have been attained. This is the largest transonic tunnel in the world owned and operated by a private company.

In one case several aircraft companies have combined resources to provide a co-operative facility that is larger and more flexible than any one could afford. This is the Southern California Co-operative Wind Tunnel operated for the sponsoring companies by the California Institute of Technology.

Another outstanding research facility is the Cornell Aeronautical Laboratory. Although owned by Cornell University and administered by it, the laboratory is engaged primarily in work on a contract basis for government and military agencies. The Cornell Laboratory has an $8^1/_2 \times 12$-ft variable-density wind tunnel for operation throughout the subsonic range. The test section has been modified so that it can, at will, be fitted with a 3×4-ft transonic test section of a type developed by Cornell engineers and capable of operation over the Mach number range from 0.9 to 1.3. Also it is provided with a propeller dynamometer that makes it possible to apply 2000 hp to a propeller while operating the tunnel over the transonic range.

Government-Owned Tunnels

In addition to the NACA, several other branches of the government operate wind tunnels. The Bureau of Standards has two small subsonic tunnels. The Navy has about 15, the largest being a 27,000-hp transonic tunnel at Carderock, Md. The Bureau of Ordnance of the Army in Aberdeen, Md., has two supersonic tunnels of 13,000 hp each.

Aside from those of NACA, the largest existing wind-tunnel center is one operated by the U. S. Air Force. This is the Wright Air Development Center near Dayton, Ohio. Located there are three subsonic tunnels. Two are small ones, but the third has a 20-ft circular test section and the relatively high subsonic air velocity of 425 mph. This tunnel, built in 1941, is powered by a 40,000-hp motor, which, for ten years, was the largest induction motor in the world. Since the war, a very small transonic and one 10-ft transonic tunnel with a 40,000-hp drive have been added at WADC. Also a 5000-hp, 2×2-ft supersonic and a 1000-hp, 6×6-in. supersonic tunnel have been built recently at Wright Field.

Fig. 3 NACA's 6×6-ft supersonic wind tunnel at Ames Aeronautical Laboratory. The compressor is shown with its stator opened to permit inspection and maintenance. In operation, two 25,000-hp motors drive the compressor creating air speeds that range from 84 mph to 1500 mph.

While the wind-tunnel facility and activity at Wright Field is sizable, it is not in the same league with what the Air Force is building at Tullahoma, Tenn. Here on a large tract of Tennessee "barrens" facilities are being erected for aerodynamic testing on an unparalleled scale. This will be the Arnold Engineering Development Center, which is, as is the Wright Field facility, a part of the Air Research and Development Command of the U. S. Air Force.

The Tullahoma plant at the outset will be comprised of three units.

The Engine Test Facility will have three test chambers and a test bed in which it will be possible to carry out research, development, and evaluation programs on turbojet, turboprop, and small ramjet engines under simulated flight conditions and altitudes up to about 80,000 ft. Temperatures as low as —120 F will be reached. Approximately 75,000 hp is required to operate the compressor and exhauster system. An adjunct to this facility is

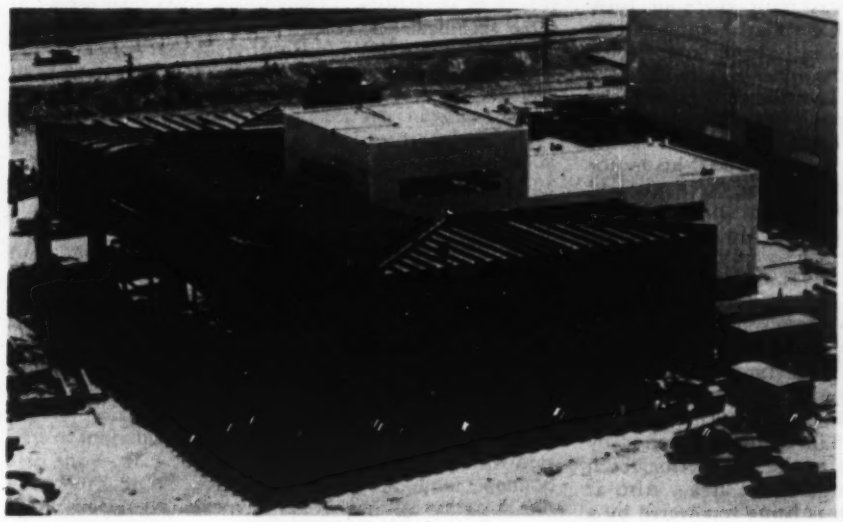


Fig. 2 The McDonnell Aircraft Company operates a transonic wind tunnel with a 7-ft $\times$ 10-ft test section. The power for this privately owned tunnel is supplied by a 1750-hp motor.

being constructed in which the largest ramjet engines now under development can be tested. Much of the equipment in ETF was found operating in Germany during the war and was brought over to this country as reparations. This facility is undergoing its shakedown and calibration runs.

The Gas Dynamics Facility will consist of a group of supersonic wind tunnels for developmental testing of models of aircraft, projectiles, and missiles designed to operate at extremely high speeds. Some of these tunnels are to operate in the hypersonic range. The primary air mover is an extremely versatile compressor plant containing six axial compressors and six contrifugal compressors driven by electric motors totaling almost 100,000 hp. One of the smaller supersonic tunnels has been in operation for several months.

The Propulsion Wind Tunnel will consist of a transonic and a supersonic tunnel, each with a test section 16 ft sq. They are intended for developmental testing of full-scale operating ramjet and turbojet power plants installed in missiles or aircraft. In addition, propellers and aerodynamic models can be tested. The two tunnels will be arranged so that both can be served by one power plant of 216,000 hp. For future expansion, space is left for the addition of a 180,000-hp motor to the present four, making available about 400,000 hp to either tunnel.

The NACA

The outstanding factor in the wind-tunnel business has been and is the NACA (National Advisory Committee for Aeronautics). While the bulk of its work is obviously of interest first to military aviation, it is not a part of the Armed Forces.

The wind-tunnel activities of NACA (it engages in other aspects of aircraft and guided-missile research) are located at three centers: Langley Aeronautical Laboratory, Langley, Va.; Ames Aeronautical Laboratory at Moffett Field, San Francisco; and Lewis Flight Propulsion Laboratory, near Cleveland. Langley is the oldest and largest both in number and variety of facilities. The first tunnel was built there in 1919. It was a 5-ft tunnel capable of only a 100-mph breeze. Since then many specialized tunnels have been erected and new ones are currently being added or rebuilt. Today, its buildings house some 20 different wind tunnels. Many are small, special-purpose tunnels such as for studies of free-flight models for spin. Largest is the "full-scale" 30 × 60 tunnel where an 8000-hp motor provides air speeds up to 120 mph. Five supersonic and four transonic tunnels are in operation or under construction. Tops for speed is one capable of Mach numbers up to 10 in a test section 1 ft sq. Powerwise, Langley's largest are two with 60,000-hp drives.

In 1940 NACA established Ames Aeronautical Laboratory, which is now equipped with some nine tunnels particularly suited to high-speed aerodynamics. The largest, physically, is the full-scale tunnel with a test section of 40 × 80 ft, large enough to take most pursuit planes and several of the small bombers. The circuit of the air passage is more than half a mile. Powered by six 6000-hp motors, air speeds in the test section reach 250 mph, very high for so large a test area. Also at Ames is the 6-ft tunnel, which is being repowered by a 110,000-hp motor for transonic operation and a 180,000-hp tunnel (216,000 hp on a half-hour basis) being constructed with two throats. A 6 × 6-ft supersonic tunnel has a 60,000-hp drive. In addition to several smaller tunnels, Ames has four large tunnels with drives totaling 422,000 hp.

Only slightly younger than Ames is the Lewis Flight Propulsion Laboratory. The principal objective here is engine research. The laboratory is now equipped with four supersonic tunnels and other facilities. Its 6 × 8-ft tunnel, capable of Mach number 1.8 with a drive totaling 100,000 hp, is the largest supersonic tunnel now in operation anywhere. A new, larger supersonic tunnel is now under construction at Lewis.

Justification for Wind Tunnels

Wind tunnels are great timesavers. In a modern or a future war even a few days' time may be without price. Flight testing will of course always be necessary, but it can be greatly reduced by adequate work done in tunnels long before the prototype aircraft are wheeled onto the runway. Flight testing is expensive, too, not only in dollars but in pilots' lives. And wind tunnels give the indispensable opportunity to test components or scale models with a succession of modifications, changing one variable at a time, all under controlled conditions with the ability to make precise measurements.

Solar-Energy Heating

THE use of solar energy for space heating is realizable and the sun's supply of energy is virtually inexhaustible, according to Prof. R. C. Jordan, Mem. ASME, head, Department of Mechanical Engineering, and J. L. Threlkeld, Assoc. Mem. ASME, associate professor of mechanical engineering, University of Minnesota, Minneapolis, Minn., who have completed a comprehensive report on the subject. Their writings were the result of extensive research sponsored by The American Society of Heating and Ventilating Engineers in co-operation with the Department of Mechanical Engineering of the University of Minnesota. The authors made their report in three technical papers presented at the 60th annual meeting of the ASHVE in Houston, Texas.

Professors Jordan and Threlkeld state that petroleum deposits, accumulating in the earth for the past 500

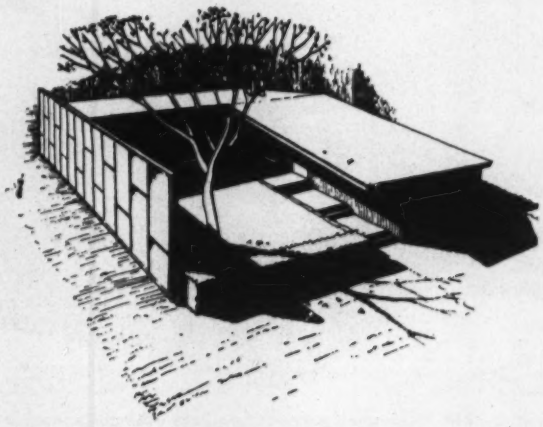


Fig. 4 Solar house with south-facing vertical collector

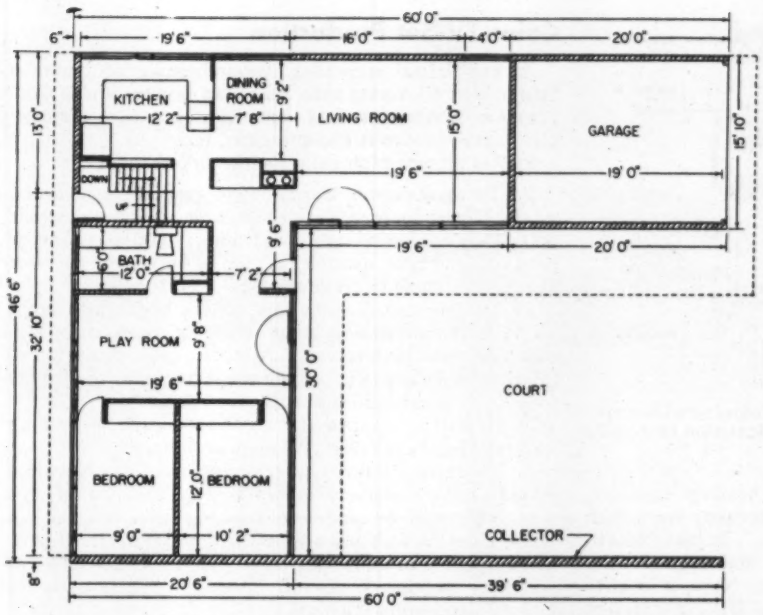


Fig. 5 Plan of house of Fig. 4 used for calculating the required collector area

million years, and coal, the result of 250 million years' storage, will be depleted in approximately 160 years. Since man, in the past 53 years, has consumed more than 85 per cent of all the fossil fuels used, a new inexhaustible source of energy like the sun is necessary.

Solar-Energy Collector Position

For example, they pointed out that the desirable orientation for a solar-energy collector appears to be a south-facing vertical position. In regard to the availability of solar radiation incident upon a south-facing vertical surface in the United States during December and January, the maximum radiation available appears to be in the southwestern section of the country centered in the states of Colorado and New Mexico. A reasonably uniform radiation exists in the Mississippi Valley Region. The Pacific Northwest and the regions immediately south and east of the Great Lakes are characterized by low amounts of winter sunshine because of excessive cloudiness. Of the total daily radiation incident upon a south-facing vertical surface outside the atmosphere during December and January at 42 deg north latitude, about 45 per cent is depleted by the atmosphere during the cloudless days. Recorded totals of daily radiation at Blue Hill, Mass., indicate that about 70 per cent of the radiation incident upon a south-facing vertical surface outside the atmosphere is depleted by the atmosphere during all days. Weather Bureau records show that the total radiation incident upon a horizontal surface at a given locality varies widely from year to year and that negative deviations from the long-time average of 30 per cent or more may be expected. Weather Bureau records also show that at many localities sequences of winter days with above-average radiation are more common than sequences of days with below-average radiation and that very dark winter days when little solar energy may be collected are commonly days with above-average temperature. Very cold days are usually days with above-average incident radiation. These are important advantages in solar-utilization systems.

Collector Efficiency

A rational method was also presented for estimating the daily efficiency of a flat-plate-type solar-energy collector. The efficiencies calculated by this method are indicative of maximum efficiencies which may be expected in an actual collector. When the difference between the collector-plate temperature and the daily average outdoor temperature is 50 F or less, daily efficiencies during January of 60 per cent or more may be expected on clear days for a south-facing vertical collector. Solar-energy heat-pump systems may operate with a much lower collector-plate temperature than direct solar-utilization systems resulting in substantially higher collector efficiencies and smaller required collector surface. Calculations indicate that a flat-plate collector with a south-facing vertical orientation should be equipped with two glass panes in the northern part of the country and one glass pane in the southern part.

Any solar-utilization system must include a heat storage facility if solar energy is to contribute more than a token part of the space-heating requirements of a building, they pointed out. Because of their large heat capacity per unit volume and large heat capacity without large temperature change, heat-of-fusion-type storage materials appear superior to specific heat or latent heat of vaporization types. In systems incorporating a heat pump, the heat-storage facility should be placed on the evaporator side.

Solar-Energy Heat-Pump Systems

The report included a rational design procedure for estimating collector area, heat-storage volume, heat-

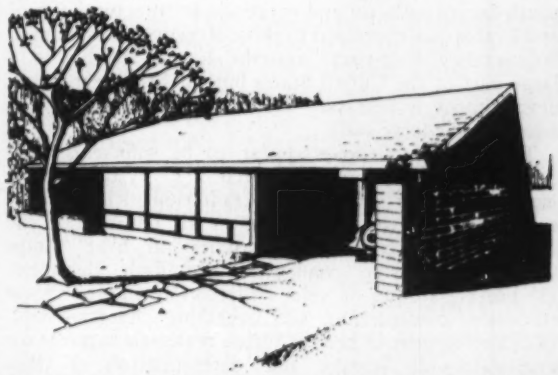


Fig. 6 Three-level solar house with south-facing tilted collector primarily for southerly regions of the United States

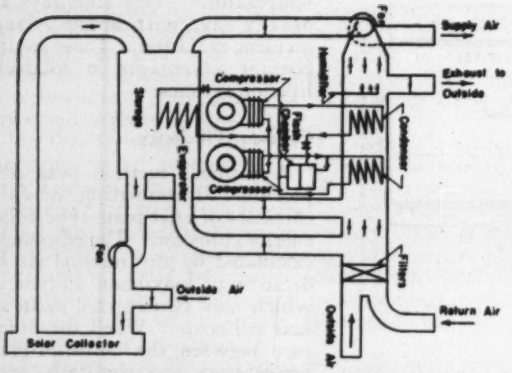


Fig. 7 Schematic of year 'round air-conditioning with evaporator side heat storage and two-step condensation heat pump

pump specifications, and auxiliary heating capacity. This procedure may be used for any locality for which the proper solar statistics are available. In many localities a solar-energy heat-pump system may require components of moderate size. At Lincoln, Neb., a locality having rather severe winters, a house having a design heating load of 62,000 Btu per hr may be heated during average winters with a system equipped with a 700 sq ft collector, a 4-hp heat pump, and a heat-storage facility using 460 cu ft of a heat-of-fusion-type material (10,000 Btu per cu ft) placed on the evaporator side of the heat pump.

In many localities, solar-energy heat-pump systems would result in lower heating costs at the present time than conventional fuel-fired systems. Substantially lower heating costs for such systems were calculated for Madison, Wis., and Nashville, Tenn. With steady depletion of the world's petroleum resources, it is reasonable to expect the relative operating economy of solar-energy heat-pump systems to be more favorable in the future. At present, such systems would have a high first cost because of the need for custom building of the solar-energy system. However, with standardization of collectors and heat-storage units, it would be possible to reduce these costs. The main problems associated with the development of solar-energy heat-pump systems involve solar collectors and heat-storage systems. No serious architectural problems appear to exist since a house may be designed to include a moderately large south-facing collector and yet retain architectural appeal and livable qualities equal to those of conventional homes. Solar-energy heat-pump systems appear feasible in a large part of the United States but further research and development is necessary before such systems may be adopted on a large scale.

The following topics appear to be sufficiently important to justify future research: (1) Pyrheliometric measurements of solar and sky radiation incident upon a south-facing vertical surface in all sections of the country. (2) Experimental studies on heat pumps using multiple-step condensers and flash chambers. (3) Further studies on solar collectors to improve their efficiency, construction, and operating characteristics. (4) Development of heat of fusion materials suitable for evaporator-side storage and determination of their performance characteristics. (5) Field studies on complete solar-energy heat-pump systems.

Color-TV-Set Production

As THE initial step in a comprehensive program to bring color television into American homes, Radio Corporation of American has begun production of commercial television sets at Bloomington, Ind.

RCA's present plan calls for the following:

1 To manufacture during 1954 (which is regarded as the "Introductory Year" for color television) about 5000 15-in. color receivers and about 5000 19-in. color receivers. These quantities can be increased to meet the public demand as it develops.

2 To ship initial color sets, which began in March, to RCA distributors in areas where network color signals can now be received. Already, color reception is possible in 35 large cities from the Atlantic to the Pacific Coast. It is estimated that by the end of 1954, 125 TV stations will be equipped for color broadcasts, providing coverage for 75 per cent of American homes.

3 To expand color programming over the National Broadcasting Company network. By the end of this year NBC will be color-broadcasting two programs a week from New York and a third program from Burbank, Calif. In addition, NBC will present a series of specially produced 90-min shows, "Spectaculars in Color," beginning in October, 1954.

West German Machine Tools

SPECIAL machinery, made in West Germany, and designed to make tools for mass production, was introduced in this country recently by Carl Hirschmann Company, Inc., Manhasset, N. Y., in the first of a series of demonstrations. The demonstration tour, under the sponsorship of established Hirschmann Branches, will extend to the West Coast where the final stop will be at

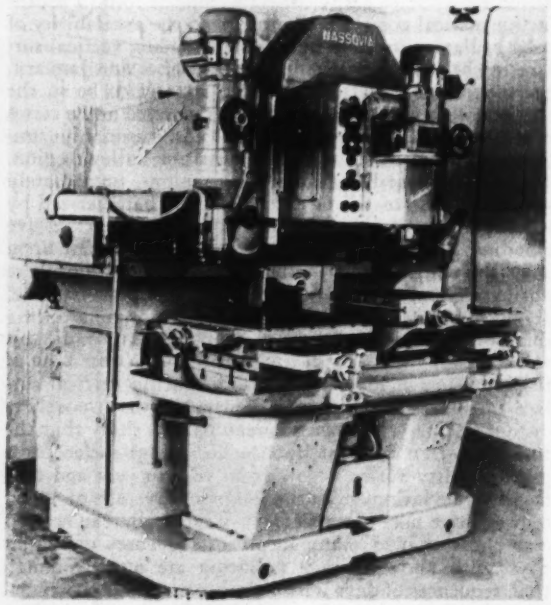


Fig. 8 Nassovia die sinker, a two-spindle fully automatic or hand-controlled machine, with electrohydraulic control

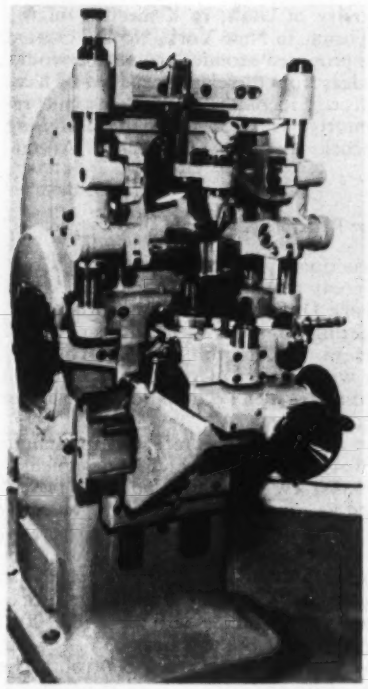


Fig. 9 Nassovia-Thiel punch-forming and shaping machine with slotter

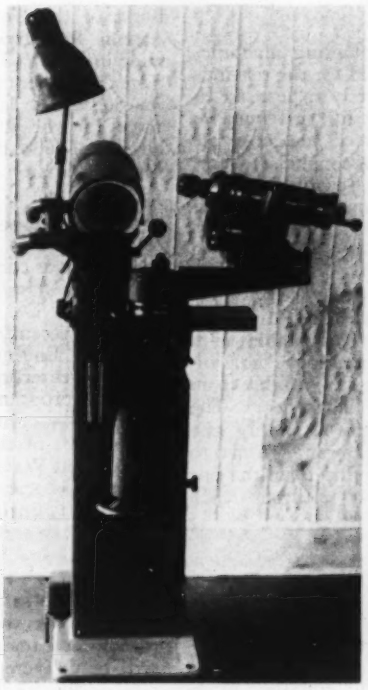


Fig. 10 Nassovia cutter-grinding and rounding machine for regrinding

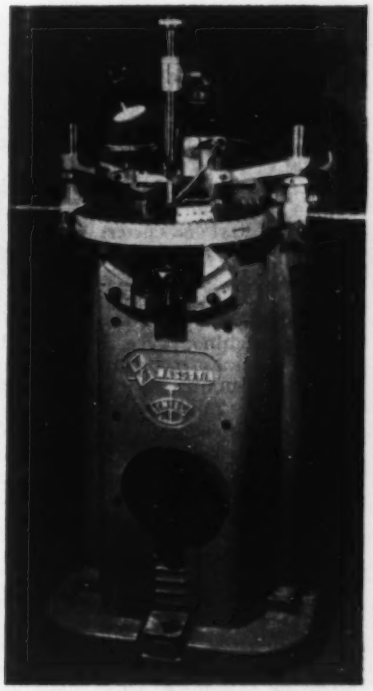


Fig. 11 Nassovia-Thiel precision reciprocating filing and sawing machine

Hirschmann, 5124 Pacific Boulevard, Los Angeles, Calif.

The machines on display were made by Nassovia Maschinen-Fabrik Hanns Fickert G. M. B. H., whose factories are at Langen bei Frankfurt Am Main. The tools being demonstrated comprise a complete installation for the manufacture of all kinds of dies, molds, and other three-dimensional forming tools. Hirschmann and the manufacturer confidently anticipate that the thorough study of performance and construction to be afforded American experts by the series of demonstrations will result in a sincere welcome to the newcomers in this country. In so far as they represent advancements in the art of diemaking, the West German machines, it was pointed out, are not directly competitive with domestic products. They will, nevertheless, lessen costs incidental to precision die-casting, molding, etc., and will appeal strongly to many who never have to make—but do often buy and use—three-dimensional forming tools of one kind or another.

The following four tools were featured: A fully automatic die sinker with electrohydraulic control; a precision reciprocating filing and sawing machine; a punch-forming and shaping machine with slotting attachment; and a cutter-grinding and rounding machine.

Die Sinker

The Nassovia Die-Sinker, Type Va 11-2, a two-spindle machine, is for the precision manufacture of forging dies, hot and cold-compression molds, embossing and drawing dies, compression and injection molds for plastics, molds for glass and rubber industries, and other three-dimensional forming tools. Plus or minus 0.0004 in. in height, width, and depth of the workpiece expresses the degree of its precision, while 0.00008 to 0.0002 in. indicates the surface quality of the workpiece measured with a Leitz-Forster instrument. On it the copy-milling of every kind of contour is possible; even vertical walls can be traced steplessly up and down.

This diemaking machine can be set for fully automatic operation or it can be hand-controlled. Where large numbers of molds are required, the two cutting spindles combined with fully automatic control provide the maximum of efficiency.

Punch-Forming and Shaping Machine

The Nassovia-Thiel punch-forming and shaping machine with slotting attachment, Type 32S-T, is for the preparation of cutting and punching tools, molds for plastics, numerous special tools, and jigs for noncutting production methods. It produces with very simple and cheap shaping tools, for example, large shaping tools for roughing, small shaping tools for finishing, hook tools, tools with lateral cutting edge, small tool bits, etc. Obviously, such simple shaping tools are no problem to any die and toolmaker and only conventional equipment is required for their regrinding.

In spite of any complexity of punch form, it is possible with the 32S-T to maintain angular precision of the profile and parallelism of the surfaces within 0.01-mm limits. This eliminates the tedious, difficult, and time-wasting hand operations, which have been a common requirement in punch manufacture, for filing and finishing.

Grinding and Rounding Machine

The Nassovia cutter-grinding and rounding machine, Type SR 1, has been especially developed for the regrinding of the Nassovia copy-milling cutter to be used in copy-milling machines. It is efficient for this purpose and also for regrinding other cutters of similar type. Typical of the tools for which it is recommended are: Single, and multiedged cutters (also end-cutting) such as Nassovia copy-milling cutters, shank cutter, cylindrical and cylindrical end-cutters, and tracers.

Filing and Sawing Machine

The Nassovia-Thiel precision reciprocating filing and sawing machine, Type 14, is readily adjustable to a variety of jobs recurring in patternmaking. For instance, the number of strokes is steplessly variable from 75 to 340 per min by simply turning a handwheel. The number is shown on a dial gage. Quite as simply, the length of the stroke is adjustable. It can range from 0 to 5 in. Changing files or saws, or changing from the one to the other, is accomplished readily with an Allen wrench.

Power From the Atom

The first few months of 1954 have witnessed a prodigious amount of atomic-power developments. It has been an extremely active period—and equally important—for this period may well be the threshold of tomorrow's practical nuclear-power reactors for peaceful purposes.

Recent Atomic Developments

Of note was the launching of the submarine, U.S.S. *Nautilus*, the world's first nuclear-powered vessel. While the *Nautilus* is a war implement, the engine suggests the possibility of a civilian atomic power plant—one that could produce enough electricity to furnish the needs of a small city. In addition, such a nuclear engine could power ocean-going liners, freighters, and the like.

Another development, unveiled during this period, was an experimental atomic battery which for the first time converted atomic energy into small but useful quantities of electricity. As envisaged by RCA, its developers, the atomic battery might provide power for miniature devices such as portable and pocket-size radio receivers, hearing aids, signal control, and so on.

The design of an atomic-powered locomotive, as presented by Dr. Lyle B. Borst of the University of Utah, to a meeting of the Atomic Industrial Forum in New York, N. Y., created wide interest. This proposed atomic locomotive would have the power of at least four diesel units and would have the pickup of an electric locomotive. The atomic reactor for the locomotive is already on the designing boards of The Babcock & Wilcox Company's Atomic Energy Division.

AEC Plans Five Power Reactors

The future construction by the Atomic Energy Commission of five different power-producing reactors was outlined by Dr. Henry D. Smyth, member of the AEC, before a recent meeting of the American Institute of Chemical Engineers in Washington, D. C. This far-reaching enterprise will be part of the AEC's proposed five-year program to arrive at an economical solution of the problem of nuclear power.

The first of these reactors is the recently announced Pressurized Water Reactor (PWR) which is designed to generate at least 60,000 kw of electric power. It will use slightly enriched uranium as fuel, ordinary water as a moderator and coolant. The reactor will be operated under reasonably high pressure and temperature, not nearly so high as are used in modern steam plants, but as high as it is safe in terms of present knowledge. Specifically, the water in the reactor will be under 2000 psi and at a temperature between 500 and 600 F. Steam will be delivered to the turbine at about 600 psi. The temperature is limited by the corrosion of the fuel elements and piping and container, and the pressure is limited by the strength and size of the vessel in which the reactor must be contained. One of the difficult problems in this reactor will be that of getting control mechanisms to operate in a high-pressure vessel. Principally, it is hoped to learn from this reactor how such a plant may stand up under ordinary operating conditions of a central-station electric power plant and how much it costs to build and operate it. It is not expected that

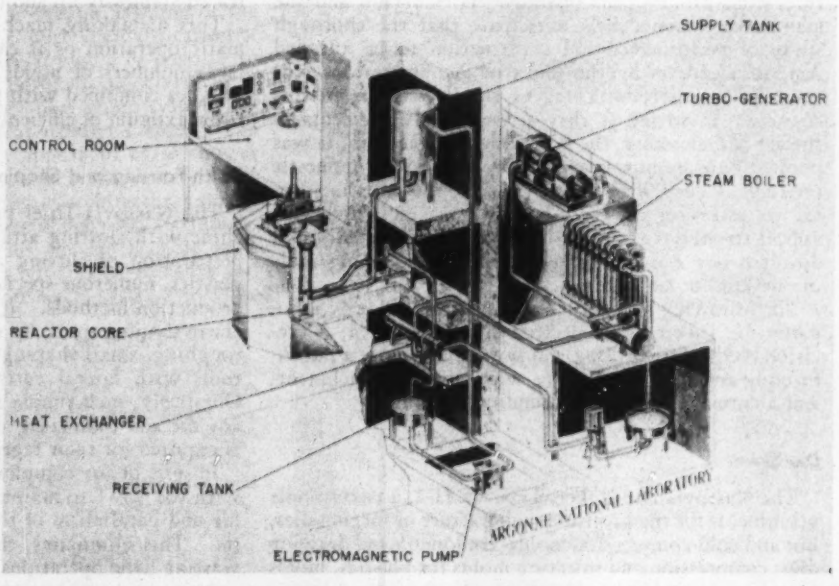


Fig. 12 Experimental breeder reactor to demonstrate whether or not breeding was possible

this reactor will produce power as cheaply as a modern coal-burning plant, but it is hoped to learn how costs can be cut in later plants.

The second new reactor planned is a breeder of intermediate size. It will not be of direct interest economically, but it will be much larger and much more nearly a power-producing, continuously operating reactor than the small experiment that has been running out in Idaho. The scale-up planned is from 1400 to 62,500 kw of heat, and from 170 to 15,000 kw of electric power. Temperatures and steam pressure will be increased to values appropriate to a full-scale power breeder reactor. Auxiliaries such as pumps, heat exchangers, valves, etc., will be of sizes suitable to a full-scale reactor.

The third reactor is based on the recent boiling experiment that was carried out last summer at the Idaho Test Site. It will be an attempt on an intermediate scale actually to use boiling of the water as a method of heat extraction. This might result in a very cheap method of getting the heat out of the reactor and possibly of eliminating one step between the coolant in the reactor and the turbines which turn the generator. It is planned to feed the steam generated in the reactor directly to the turbines. Present plans call for 20,000 kw of heat and 5000 kw of electric power.

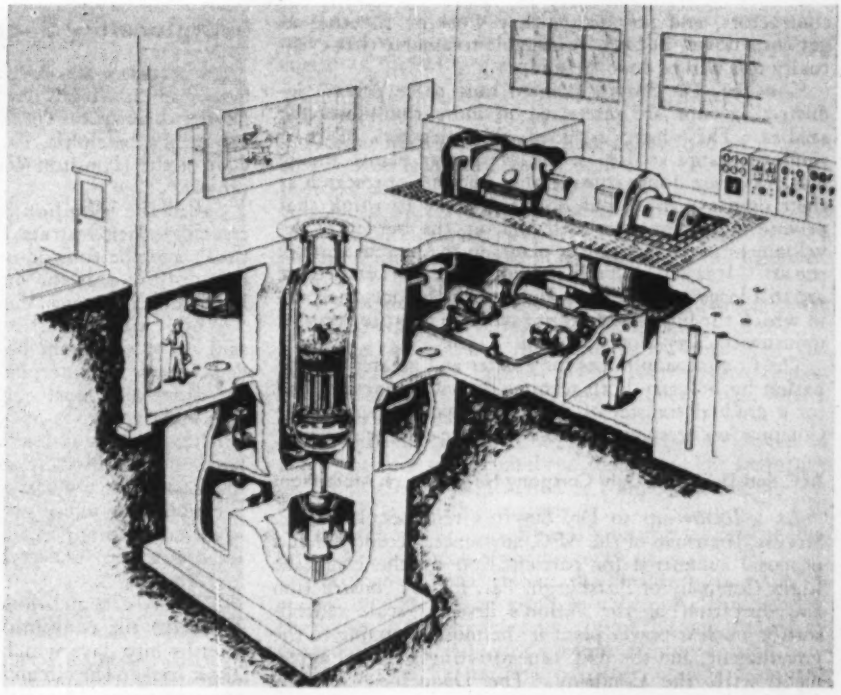


Fig. 13 This artist's conception of the experimental boiling-water reactor was shown for the first time by Dr. Lawrence R. Hafstad, Director of the Division of Reactor Development of the U. S. Atomic Energy Commission, in a talk before the annual meeting of the Institute of Radio Engineers, New York, N. Y. The boiling-water reactor plant will have an output of 5000 kw of electricity. In this reactor water will be converted into steam directly without the use of an intermediate heat-exchange system. The tall, cylindrical tank in the center of the picture is the pressure vessel which has been cut away to reveal uranium fuel assemblies and water being converted into steam. This steam is carried to the turbine and electric generator, upper right. The control room is to the left of the generator. A condenser, in which steam leaving the turbine becomes water again, and pumps for returning this water to the reactor are below the turbine and generator. The holes in the concrete on the right of the diagram are used for storing highly radioactive, partly used fuel elements, pending disposal.

The fourth reactor in the planning stage is a larger version of the homogeneous reactor. Again, it will be a step in the direction of a practical power-producing unit and should give information about corrosion, chemical processing, and operating conditions that cannot be obobtained with the small machine now in use at Oak Ridge.

Present specifications call for only 3000 kw of heat in this reactor experiment compared to 1000 in the present experiment. The next step, already planned, calls for 65,000 kw of heat in a homogeneous reactor which will breed uranium 233 in a blanket of thorium surrounding the chain reacting core.

The fifth reactor experiment is a little different from any described. For example, the breeder reactor uses sodium-potassium alloy as a coolant and the Hanford reactors use graphite as a moderator. It is planned to combine these two materials, getting the advantage of high temperature without high pressure from the sodium coolant. To test this combination, a reactor generating about 20,000 kw of heat but without any electric-generating plant attached, will be built.

In addition to these new proposals, other programs already under way, such as the so-called intermediate submarine reactor now under construction at West Milton, N. Y., and the development of a reactor to propel aircraft will be continued.

Costs and Industrial Participation

It is evident that power plants can be built which will convert the energy released in nuclear fission into electrical energy to be fed into transmission lines. The question that has not been answered and may not be conclusively answered even by this program, Dr. Smyth said, is whether this power can be produced cheaply enough to be of general use. The Atomic Energy Commission believes that it can be done and this is the opinion also of the several private industrial groups who have been studying the problem for several years at the invitation of the Commission. At present, the power delivered by the submarine reactor at Idaho costs about ten times as much as it would if it were bought from the Idaho Power Company. From this figure it is evident that it will require all the ingenuity of the AEC staff, its

contractors, and private industry working together to get costs down, but it is reasonable to assume that eventually this will be done, he said.

However, Dr. Smyth pointed out, these private industrial groups are interested in more than just cost studies. They have assigned able members of their staffs to design studies of nuclear power plants and in some cases are doing considerable amounts of research at their own expense. But it is a mistake to think that private industry can or will pick up the burden of development of nuclear power plants in the present state of the art. It is a field in which knowledge and competence are still largely confined to government laboratories and in which the financial risks are still too great for private industry to carry alone.

The Commission hopes for greater and greater participation by industry both technically and financially and for a gradual transfer of the nuclear power part of the Commission's responsibilities to private enterprise.

AEC and Duquesne Light Company Negotiate on Atom Plant

As a follow-up to Dr. Smyth's remarks, Lewis L. Strauss, chairman of the AEC, announced recently that a proposal submitted for participation by the Duquesne Light Company of Pittsburgh, Pa., for the construction and operation of the nation's first full-scale central-station nuclear-power plant is the most favorable to the government, and the AEC is negotiating a formal agreement with the Company. The Duquesne Company submitted one of nine major proposals to the commission.

Under the Duquesne proposal the Company would: (1) Furnish a site for the entire project and build and operate a new electric-generating plant at no cost to the government. (2) Operate the reactor part of the plant and bear the labor costs thus entailed. (3) Assume $5 million of the cost of research, development, and construction of the reactor portion of the plant. (4) Pay the Commission at the rate of 48.3 cents per million Btu's of steam used in the turbines for the first year; the rate increasing annually until it reaches 60.3 cents in the fifth year. (5) Waive any reimbursement by the government of costs incident to termination of the contract.

The chairman estimated that, including revenues from the sale of steam generated by the reactor, the Company's proposal would reduce by an estimated $30 million the expenditures the government would have to make during the period of construction and five years of operations if it undertook the full cost of the project.

The proposed plant site is on land presently owned by the Company in the Greater Pittsburgh Area. The reactor design will incorporate safety features developed through ten years of experience with reactor operation.

The Westinghouse Electric Corporation has a contract with AEC to develop, design, and construct the reactor portion of the plant. The 60,000-kw PWR reactor described by Dr. Smyth was chosen.

Power Reactor Studies Authorized

A further step in the nuclear-power direction was achieved when the AEC recently approved separate study agreements with American Machine and Foundry Company and The Babcock & Wilcox Company, New York, N. Y., and Bendix Aviation Corporation, Detroit, Mich., looking toward the practical application of atomic power and its by-products. The projects will run for a year, with costs borne by the companies.

Interplanetary Space Clock

AN INTERPLANETARY space clock, said to be the world's first, was introduced recently by its inventor, Dr. I. M. Levitt, director of The Franklin Institute's Fels Planetarium, Philadelphia, Pa., and George P. Luckey, president of the Hamilton Watch Company, sponsors of the project.

Called the Hamilton Space Clock, the timepiece was created to demonstrate the differences between "Earth time" and the time on other planets. The clock simultaneously records the hours, date, month, and year on Earth and the planet Mars.

While still in the experimental stage, the clock is said to be important because it is the first attempt to demonstrate the interplanetary time differentials a future space explorer must consider when planning journeys into outer space.

After completing a series of astronomical calculations, Dr. Levitt asked the Hamilton Watch Company to turn his theory into a working model.

Hamilton assigned one of its top engineers, Ralph B. Mentzer, assistant director of its Process Development Laboratory, to undertake construction of the world's first space clock.

The clock, which holds four dials, divides the Mars year into the conventional twelve months, and those months into days which—on Mars—are 24 hr, 37 min, 23 sec long. The circumference at the face itself indicates Martian time. One dial set into the face records Earth time, while the other two are month-and-year calendars for both Earth and Mars. The face and exposed works are enclosed in an egg-shaped amber plexiglas casing which is mounted on a square pedestal with two rectangular brass feet.

Among the dramatic differences in living on another planet which the clock demonstrates are the following:

Fig. 14 World's first space clock tells time on Mars, Earth. The clock, which is 16 × 16 × 14 in., divides the Mars year into the conventional 12 months and into Mars days of 24 hr, 37 min, 23 sec. Numbers around the face indicate Martian time. The small dial, center, tells Earth time. The dial at the left is the Mars month-year calendar; the other, Earth.

Fig. 15 Ralph B. Mentzer, Hamilton engineer, works on world's first space clock which demonstrates the interplanetary time differentials a future space explorer must consider when planning a journey into outer space—for example, Mars

If you are used to an eight-hour work day on Earth, you will work about 12 min longer on Mars. While a year goes by on Earth, only slightly more than half a year has elapsed on Mars. A young lady of 21 on Earth, would theoretically find herself just $11\frac{1}{2}$ years old on Mars. A two-week Earth vacation would be stretched to almost four on Mars.

For demonstration purposes, Dr. Levitt provided an accelerator to speed up movement of hands on the clock by more than 2000 times to show graphically the time differential existing between the two planets. This "time-flyer" is an integral part of the space clock.

5 BEV Particle Accelerator

THE world's most powerful particle accelerator, the University of California Bevatron, has gone into successful operation. The machine has accelerated protons, the nuclei of hydrogen atoms, to an energy of 5 billion electron volts (BEV), the highest energy ever achieved by an accelerator.

The Bevatron went into operation approximately six years after its design first was conceived and four years after construction began. The $9 million machine was built with AEC funds.

Lewis L. Strauss, chairman of the U. S. Atomic Energy Commission, said the operation of the machine constitutes another step forward in the AEC's program to keep America in the forefront of atomic progress.

First successful acceleration was achieved February 15, when the protons reached 20 million electron volts. The energy was built up gradually until 4.7 BEV was reached on the evening of March 9. UCRL physicists now are working to push the machine to its design energy of 6.25 billion electron volts.

The following is a brief summary of the operation of the machine:

Protons from an ion source are accelerated in a Cockroft-Walton generator to 500,000 electron volts. The protons' energy is increased to 10 MEV in a linear accelerator. By means of an "inflector," the beam is brought into the accelerating chamber of the Bevatron at such an angle that the particles are caught by the magnetic field.

The particles circle the accelerating chamber some 4,000,000 times, traveling about 300,000 miles.

During this journey the particles are guided by the magnetic field over a precise orbit. As the particles gain energy, the increasingly strong magnetic field forces them to remain in this prescribed orbit.

The particles receive an average of about 1300 volts of energy on each trip around the chamber. The frequency of the oscillator is increased to compensate for the increasing speed of the particles.

Thus the machine incorporates both frequency modulation and variation of the magnetic field.

The protons emerge from the Bevatron at a design energy of 6.25 billion electron volts. At this energy, the design particles are cosmic rays of the medium-energy range. Twenty pulses of protons a minute, each containing about 100 million particles, emerge from the machine.

The beam of protons knocks neutrons and protons out of atoms. It generates showers of mesons and other synthetic secondary cosmic-ray particles.

These cosmic-ray events are detected and studied by means of counters, photographic emulsions, and cloud chambers.

Helicopter Gas Turbine

A GAS-TURBINE engine for helicopters which will be comparable in size to the conventional piston power plant in the family automobile, but six to eight times more powerful, is being developed by General Electric Company, Lynn, Mass.

Designated the XT-58, the gas turbine is being designed for the Navy's Bureau of Aeronautics primarily to power helicopters. However, with some modifications, it can be adapted as a power plant for fixed-wing aircraft either as a turboprop or turbojet.

These applications, it was pointed out, offer particular promise of small gas-turbine engines for military trainers. Another possible application is as a booster for planes powered by reciprocating engines.

As applied to a helicopter the gas-turbine engine, it was explained, will give a smooth, quiet, vibrationless ride. The low noise level of the engines should reduce flying fatigue on both passengers and crew.

In addition to comfort, G-E engineers predict this small gas-turbine engine will offer many economies for helicopter operation. Not only is the engine smaller, lighter in weight, and easier to install, but preliminary studies indicate that it will use less oil and will be easier to cool than other engines of comparable horsepower. The power plant will burn the inexpensive fuel associated with such gas generators.

Fig. 16 Right front view of the T74 tank-recovery vehicle

Fig. 17 Right rear view of the T74 tank-recovery vehicle

Fig. 18 Tank-recovery vehicle is shown here hoisting M48 tank with boom in stowed position; hook is in up position

Fig. 19 Here tank-recovery vehicle is shown lifting an M48 tank with boom raised; stabilizing spade is in down position

Tank-Recovery Vehicle

OUTMODED World War II tanks, instead of being relegated to the scrap pile, are now being put to work as recovery vehicles by means of a relatively inexpensive redesign program. The idea was fostered by E. W. Holt, senior tank automotive engineer of the Army Ordnance Field Service.

Ever since the Army first made tanks, Army Ordnance Field Service personnel reasoned that if a tank was designed to destroy a tank, then a tanklike wrecker could be designed to rescue a damaged tank and prevent capture or destruction by the enemy. (Today's Patton 48, the 50-ton medium tank, costs American taxpayers about $200,000 each.)

At the request of the Office, Chief of Ordnance, the Philadelphia Ordnance District explored the possibility of engineering this dream into a practical reality. The York Regional Office asked Bowen-McLaughlin-York, Inc., of York, Pa., a firm specializing in rebuilding Ordnance combat vehicles, to undertake this work. This was a tough order, since it meant converting the battle-weary World War II M4A3 Sherman medium tank into a modernized superefficient workhorse, that could rescue our newer and larger tanks under combat conditions.

B-M-Y engineers came up with the answer that the job could be done, and at moderate cost. In May, 1952, the first pilot model, designated as the T74 Recovery Vehicle, was placed on order with Bowen-McLaughlin-York, Inc., and delivery made to Army Field Forces in July, 1952. Based upon the results of rigorous tests by the Army at Ft. Knox, Ky., a second pilot, incorporating all changes desired by armor personnel, was built and shipped to Aberdeen Proving Ground for further shakedown tests, in December, 1952.

The prime contract for quantity production of the new T74 Recovery Vehicles was awarded to the Bowen-McLaughlin-York Company. The firm immediately placed subcontracts with over 300 suppliers.

The new tank-wrecker, weighing nearly 50 tons, is specifically engineered to support the newest and latest model medium tanks currently being produced for the Army. It costs nearly $200,000 to build each of these new fighting tanks, whereas the T74, salvaged from the scrap pile, costs less than one third of that amount to produce.

When combat tanks are severely damaged by enemy land mines or shell fire, or become hopelessly mired down in torn-up battlefields, the call for the recovery vehicle is immediate and urgent. The T74 is capable of towing damaged tanks cross-country as well as hoisting and winching a tank out of mud and deep ditches, or flipping upright an overturned tank.

Huge winches, hydraulically operated, provide hoisting capacity sufficient to pick up all but the heaviest of the new tanks. A wholly new concept of transmitting power to these winches has been incorporated. Precision controls and high safety factors have been engineered into the T74. The hydraulic system, which was designed and built by the Dudco Division of the New York Air Brake Company, is the charged, pressurized

type operated by pilot control valves, transmitting full torque at infinitely variable speeds. For example, less than one pound effort by the operator applied to the control valve lever, will control a line pull of 85,000 lb, whether the line travels 6 ipm or 50 fpm.

The T74 is equipped with a front spade so designed as to stabilize the vehicle for extremely heavy lifting and/or towing. The design of the spade also permits its use as a bulldozer. This feature permits the improvement of terrain when adverse conditions prevail at the site of recovery operation. The spade may be stowed, released, and adjusted to desired height for all operations from within the vehicle, without the exposure of the crew to hostile fire.

The boom is raised into operating position by hydraulic cylinders, which may be used to provide a live boom, allowing the spotting of heavy loads fore and aft with precision control, when movement of the vehicle is not actually desirable.

Electrical Equipment Exhibit

Some interesting products, many of which up to now had been on the restricted list, were displayed recently by Bogue Electric Manufacturing Company, Paterson, N. J., on the occasion of its new plant-facilities dedication.

An array of some 42 exhibits and demonstrations highlighted the program. Outstanding among these were the following:

A rotary actuator-type transistor magnetic-amplifier-controlled ship's steering mechanism now being installed on six new Navy tankers. It is a fully automatic device for steering large ships accurately and compensating for wind and current. In this system a 1/10 microwatt signal from the gyro can produce a 5000-lb torque at the rudder.

A sonic liquid-level indicator which measures the level of liquid in either open or closed tanks within a radius of 2000 ft to an accuracy of within 1/100 of a foot. It is not affected by corrosive liquids, and it also can measure radioactive fluids without requiring anyone to come near them.

Fig. 20 Sonic liquid-level indicator under actual operating conditions. The operator at the control station reads the indicator as the instrument measures the level of liquid in open or closed tanks within a 2000-ft radius of the set within $^{1}/_{100}$ ft.

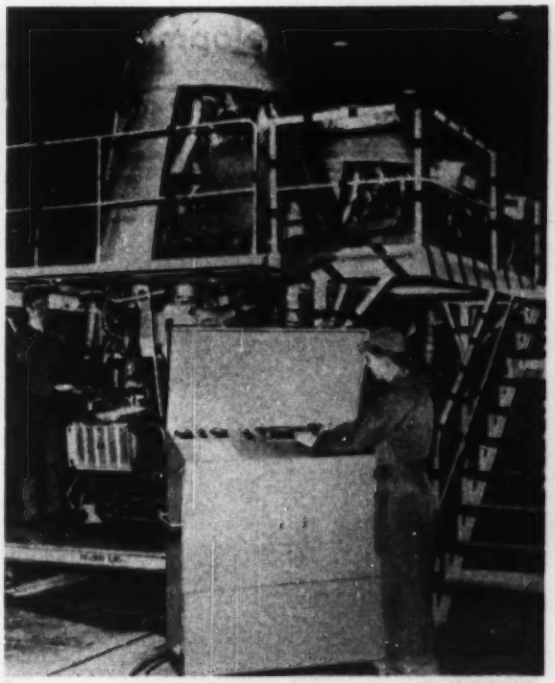


Fig. 21 A view of automatic engine nacelle tester in use on the production line. This tester is also used on the flight line

A continuous bearing-temperature monitor with which a continual, accurate, and automatic check can be made on the temperature of all operating bearings in ships at sea, public-utility installations, and the chemical industry.

An automatic nacelle tester for use on the flight line or production line. This device will check the electrical circuits in an aircraft engine or complex navigational or bombing systems, at the rate of 100 circuits every eight seconds.

The "Joy Stick" submarine control, a new system of "flipper" control so designed that one man can readily control the movements of a submarine, whereas this same operation previously required three.

A power-system control apparatus which will control all electrical power in the *Sea Wolf*, the U. S. Navy's second atomic submarine.

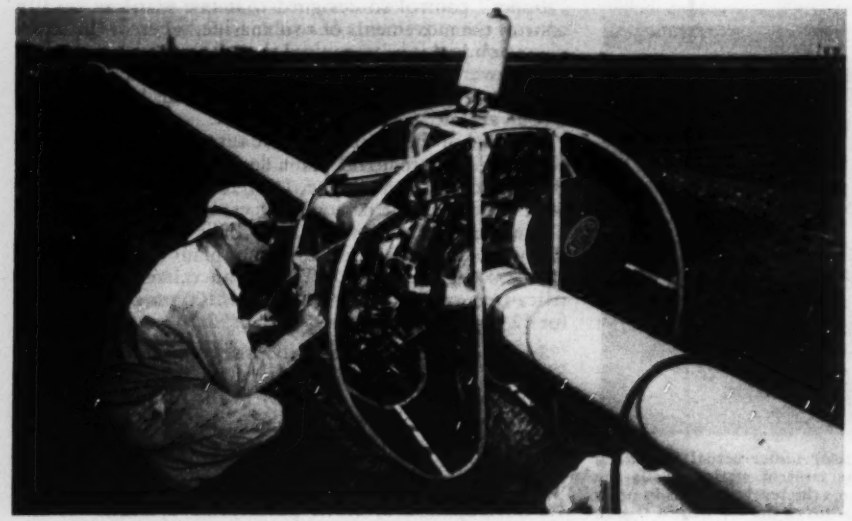
A model of the world's largest automatic demineralization and silica-removal plant designed and produced by Belco, a division of Bogue, for treatment of boiler feedwater at one of the nation's largest chemical companies. The untreated water, taken from Lake Huron, is pumped throughout the demineralization plant at the rate of 10,800,000 gal per day. The demineralized, practically silica-free, treated water constitutes 100 per cent make-up for 1250 psig boilers.

In addition to discussing the foregoing in his welcome address, E. P. Schinman, president of Bogue, pointed up the work done by the company in the field of high-cycle generators, particularly the 400-cycle generator. The company's degaussing systems, he said, have protected not only vessels of the U. S. Navy, but also of the Royal Canadian Navy. He added that Belco is continuing its development of water-purification systems.

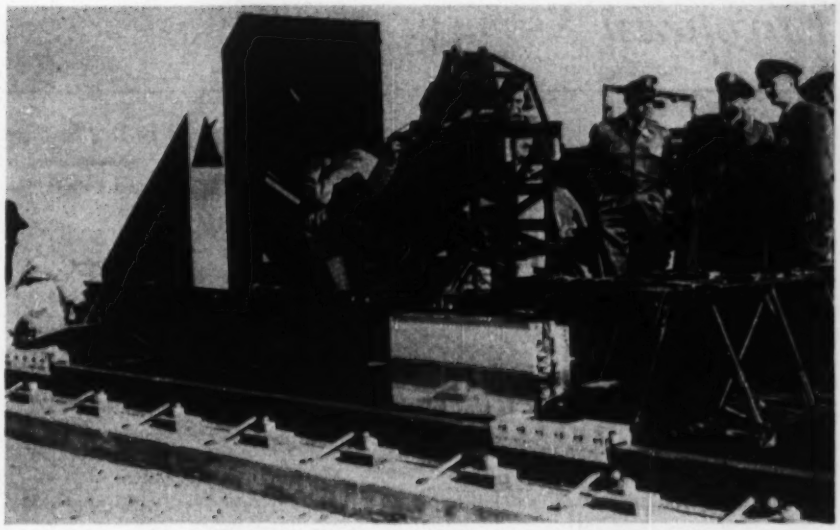
Engineering developments . . . at a glance

Jet Torch. This jet-torch operator is removing excess metal from a large pressure-seal valve body at the Reading, Pa., foundry of the American Chain & Cable Co. The torch generates heat of 6000 F which instantly melts away the desired area of the casting. It consists of a $^1/_4$-in-diam carbon electrode, secured in a holder, with a small air jet beneath it. When ignited the electrode generates an electric arc which melts shrinks, cracks, fused-in sand, fins, brackets, etc., like water. The accompanying jet of air blows the molten metal and slag away, leaving a casting of generally uniform contour. The area cools quickly and is then rebuilt with sound weld metal.

X-ray Technique. Inspection of irregularly shaped jet-engine parts is being speeded up in Solar Aircraft Company's plant in Des Moines, Iowa, by means of an x-ray technique borrowed from the medical field. Developed by the Picker X-ray Corporation, the device is a thin-walled rubber bag, filled with fine plastic granules and equipped with a portable electric vacuum pump. When air is partially evacuated from the bag, it becomes pliable and can be molded to any shape. When the air is fully exhausted, the bag and its contents become extremely rigid, holding any previously molded shape. Here the operator is shown checking a final setup before x raying the part.



Automatic Welder. Shown at left is a new portable automatic pipe welder which permits 40-ft lengths of aluminum pipe to be lined up, welded into the line, and lowered into a ditch at an average rate of one every four minutes. Developed by Reynolds Metals Company in conjunction with Air Reduction Sales Company, the new machine is being used in laying a 12-mile high-pressure pipe line near Corpus Christi, Texas. Suspended over the line by a side boom, the welder is equipped with quick-acting clamps which securely grip the pipe. A button starts the welding and automatic controls maintain a proper arc. When completed, the machine stops, reverses itself, and returns to starting position.



Rocket Sled. Human volunteers will ride this 750-mph rocket sled to aid in the development of equipment enabling air crews to survive bailouts from airplanes traveling faster than the speed of sound. Tests will be conducted on a 3500-ft railroad track at the Holloman Air Development Center near Alamogordo, N. Mex., by scientists of the Air Research and Development Command. Equipment was designed and built by Northrop Aircraft, Inc., Hawthorne, Calif. It consists of two sleds—an 84-in-wide, 150-in-long test vehicle, and an 84-in-wide, 90-in-long propulsion vehicle. Speeds up to 750 mph are provided by twelve 4500-lb thrust rockets. The propulsion vehicle pushes the test vehicle until it reaches the required speed and then is retarded while the test vehicle coasts free at speed during the brief testing period. The test sled is built to withstand forces 400 times greater than the brakes of an automobile can supply. Test results will simulate a bailout from an open seat at 40,000 ft at a speed of 1800 mph. Subjects will be strapped in a chair that will rotate them head over heels 180 times per minute exposing them to the same air-blast forces that would be experienced by a pilot ejected suddenly from a supersonic airplane. Instrumentation will record the reactions of the subject and the survival equipment during each test run.

Vertical Take-Off Planes. Pictured here are two new experimental Navy aircraft designed for taking off and landing in a vertical position and flying horizontally at fighter-plane speeds. On the left is the Convair XFY-1 built by the Consolidated Vultee Aircraft Corporation, San Diego, Calif. On the right is the Lockheed XFV-1 built by Lockheed Aircraft Corporation, Burbank, Calif. The experimental models normally rest on the ground in a vertical position. They are designed to take off vertically and assume a normal flight position after getting in the air. Both are powered by turboprop engines equipped with contrarotating propellers. A specially designed rotatable seat arrangement will enable the pilot to assume suitable positions for the take-off, landing, and flight positions of the airplane. The planes have been under construction for a period of approximately three years. Engine and preflight tests of the new models are currently in progress.

European Survey

Engineering Progress in the British Isles and Western Europe

J. Foster Petree,[1] Mem. ASME, *European Correspondent*

Small-Power Gas Turbine

An experimental gas turbine designed and constructed by M. René Planche, of Villefranche-sur-Saône, France, has been awarded the Grand Prix de l'Invention for 1953, by a jury under the presidency of Prof. A. Caquot. As the diagram shows, it consists of a rotor having a lobe which engages with a recess in a second rotor of equal body diameter, the two rotors being in rolling contact and connected by gearing outside the casing. The working fluid enters under pressure at one side and travels round inside the casing, pushing the lobe before it, to escape at the exhaust port on the other side; in effect, the machine is a rotary pump of the rotary-abutment type, operating in reverse. The inventor describes it as a "volumetric turbine." On test, using hot air at 134 C and a pressure of 8.1 kg per sq cm (115 psi), the turbine drove a d-c generator at 1530 rpm, giving an output of 22.5 amp at 140 volts, or 6.2 hp. The temperature of the exhaust was 23 C and the consumption of air was at the rate of 120 cu meters an hour. The efficiency of the turbine was 92 per cent.

The main field of application that M. Planche has in view is that of automobiles, for which he proposes to use two turbines, compounded, with a compressor of the rotary sliding-vane type, in two stages with an intercooler. In an article in *Le Génie Civil* (France) of March 1, he states that the tests have indicated no practical problems that cannot be resolved from present knowledge. Since the test described in *Le Génie Civil*, the turbine has been run on gas at 250 C and is to be tried shortly with the exhaust gas from a diesel engine, at 550 C.

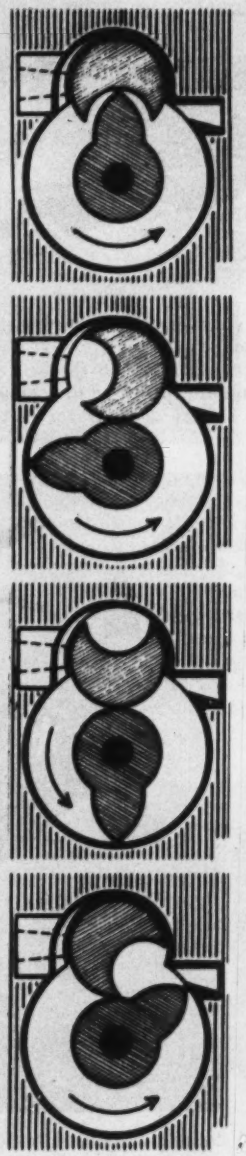


Fig. 1 Planche gas turbine. In operation working fluid enters at left and exhausts at right.

Freeing Navigable Channels of Ice

It is reported from Stockholm that a new method of keeping navigable waterways free from ice has been tested successfully in Sweden. A pipe, fitted with nozzles at intervals, is laid along the bottom of the channel and air is forced through it by a compressor. The rising bubbles of air entrain the warmer water from the bottom and carry it to the surface in sufficient quantity to prevent freezing and even to melt a thin coating of ice.

The method, which was developed in conjunction with the Atlas Diesel Company, Swedish makers of compressed-air plant, was tried in a ferryboat channel between two islands in Lake Mälar, near Stockholm. The tube, of $1^1/_2$ in. bore, was 900 meters long and had 0.75-mm-bore nozzles at every tenth meter. The maximum depth of water is about 20 meters. In temperatures down to minus 23 C, the channel was kept completely free from ice. The cost of the installation was only 10,000 kr (about $2000), which was approximately the amount previously expended every year in keeping the route open. It is suggested that the method should be of value in keeping a clear water space in front of wharves, shipyards, etc., under winter conditions.

Tractor-Mounted Portable Air Compressor

Most farm tractors are now fitted with hydraulic or other power-operated gear to lift the implements clear of the ground when necessary. An English firm of makers of air compressors and compressed-air tools—Holman Brothers, Ltd., of Camborne, Cornwall—have devised a new use for this gear. A small compressor, complete with its drive and a cylindrical air receiver, is mounted in a tubular steel framework which can be picked up by a tractor by means of its lifting gear and transported to wherever it is required. There it is lowered to the ground and can then be driven through the power take-off from the tractor's gearbox. The unit, known as the "Holpack," is supplied at present in two sizes. The one illustrated has a compressor with a maximum displacement of 84 cfm, delivered at 125 psi, and is designed for attachment to a Ferguson tractor, which can be supplied at option with an engine to run on either diesel oil, vaporizing oil, or gasoline.

A larger unit is made for use with a Fordson tractor, which may be fitted either with a diesel engine or a gasoline engine. In this instance, the maximum dis-

[1] Correspondence with Mr. Petree should be addressed to 36 Mayfield Road, Sutton, Surrey, England.

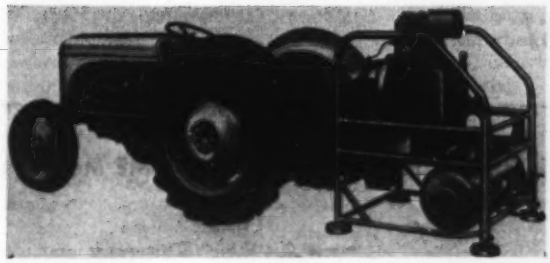


Fig. 2 Holpack compressor attached to a Ferguson tractor

placement is 130 cu ft at a maximum sustained delivery pressure of 125 psi. When lifted for traveling, the weight of the compressor and frame is taken by a safety latch. The unit can be detached in less than two minutes from the tractor, which can then be used for other work. The idea has obvious possibilities of extension in other directions, for example, the attachment of a portable fire pump or a small circular saw.

Bled-Steam Air Heaters for Marine Boilers

HEATING of the combustion air by bled steam, a novelty in marine-boiler practice, is being adopted for the Foster Wheeler boilers of the 33,000-ton oil tanker *World Harmony*, now being completed by Vickers-Armstrongs

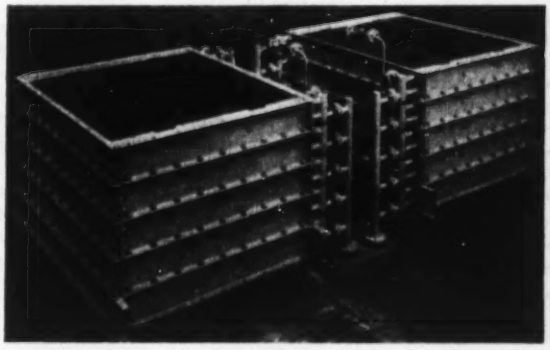


Fig. 3 Weldex bled-steam air heater for *World Harmony*

Ltd., at Walker-on-Tyne, England, and in the passenger-and-cargo liner *Orsova* constructed by the same builders at their Barrow shipyard for the Orient Line. This type of heater has been developed by the Wellington Tube Works, Tipton, Staffordshire, and consists of banks of cold-drawn seamless steel tubes, 1 in. in diam and 10 swg thick, on which are set closely spaced gills of steel plate, measuring 3 in. × 2 in. and normally 11 swg thick. The usual spacing of the gills is $^1/_8$ in. apart, but any spacing can be specified, according to requirements; the closer the gills, the more compact is the heater for a given total heat-transference. The ends of the tubes are welded into steel-tube headers, which are then assembled in a rectangular casing of steel plate.

The method of construction is ingeniously simple. The gills each have a punched central hole, just large enough to allow the tube to pass. They are assembled in a rack which holds them at the desired distance part, with the holes axially true. The tube is then threaded through them and is expanded in place by a mandrel, slightly larger than the bore, which is drawn through it by hydraulic power. The effect is not merely to make the tube fill the holes but to force out the metal of the tube wall slightly between the gills, thus holding them rigidly in their respective positions. The heaters in the *Orsova* (which, incidentally, have gills 18 swg thick) are designed to raise 166,000 lb of air per hr from 80 F to 210 F. The steam condensed for this duty is 5360 lb per hr, supplied at 35 psia and 313 F. Each heater has a by-pass capable of handling about 25 per cent of excess air during overload periods. The bled steam is taken from the main turbines under normal conditions and from the auxiliary steam range when the main machinery is not in use.

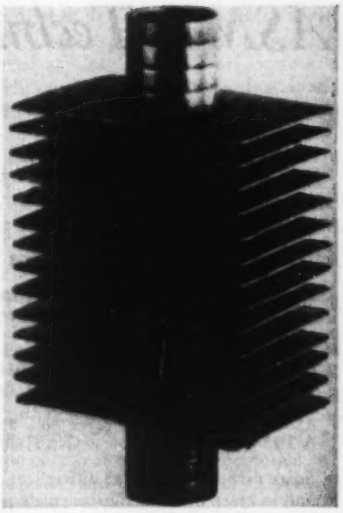


Fig. 4 Portion of element of Weldex bled-steam air heater. Some gills of the tube bank are removed to show penetration into metal tube.

Sulphur in Fuels

THE Institute of Fuel, London, England, is arranging a conference on "The Removal and Recovery of Sulphur in Fuels," to be held in London on October 6 and 7, 1954.

Sulphur is becoming increasingly important in industry and British industry, in particular, has been suffering from a shortage of it. In fuels, on the other hand, there is often too much, for the progressive exhaustion of the higher-quality coals in the United Kingdom is forcing the iron and steel industry, and the carbonization industry, to use a greater proportion of coals of relatively high sulphur content, to their disadvantage. The conference is being convened, therefore, for the purpose of studying the occurrence of sulphur in the available fuels, including petroleum, its effects on industrial practice, and the methods of removing and recovering it. Thirteen papers will be presented during the four sessions, the first, of an introductory character, by Dr. A. Parker, director of the Fuel Research Station of the Department of Scientific and Industrial Research.

The other papers will deal with the effect of sulphur in the iron and steel industry; sulphur in British coal—its occurrence and removal; sulphur in town gas and coke-oven gas—occurrence and removal; new techniques for the removal of sulphur from fuel gases; sulphur in petroleum; and the sulphur requirements of industry. Further particulars of the conference may be obtained from the secretary, The Institute of Fuel, 18 Devonshire Street, London, W.1.

ASME Technical Digest

Substance in Brief of Papers Presented at ASME Meetings

High-Temperature Steam Generation

Comparative High-Temperature Properties of British and American Steels, by W. E. Bardgett, The United Steel Companies, Ltd., Research and Development Department, Rotherham, and C. L. Clark, The Timken Roller Bearing Company, Steel and Tube Division, Canton, Ohio. 1953 ASME Annual Meeting paper No. 53—A-195 (in print; available to Oct. 1, 1954).

Some rather substantial differences are found in creep data on similar steels published in various countries. In view of the importance of these differences in relation to design stresses, arrangements were made for an exchange of specimens between The Timken Roller Bearing Company and The United Steel Companies in order to determine whether the results from the two laboratories, on the same steel, would be in agreement, and to compare the creep resistance of selected steels.

Five representative high-temperature steels were chosen comprising three commonly used ferritic steels and two austenitic steels. For each composition, four creep curves were obtained, two by each laboratory. Stress, temperature, and time adopted in the tests in the two laboratories were the same and no attempt was made at standardization of test procedure. A high degree of reproducibility was shown by the test results for the two laboratories on the ferritic steels but those on the austenitic steels showed generally substantial differences.

Only two British steels, both of ferritic type, showed similar creep behavior compared with the corresponding American steels, the remaining three steels showing appreciable differences, which are discussed.

The paper concludes that:

1 American and British laboratories are able to check one another in the determination of the creep characteristics of ferritic steels.

2 Quite substantial differences in creep behavior of austenitic steels can occur in tests in the American and British laboratories. This is attributed to the greater sensitivity of austenitic steels to variations in heating period prior to testing and in rate of loading. In any one laboratory these conditions must be closely controlled with austenitic steels in order to obtain good reproducibility.

3 The creep properties of steels of the same analyses are not always the same. Only the three ferritic steels come in this category. Good agreement was obtained with two of these, while the third showed quite a marked difference.

4 Steels of similar type show substantial differences in creep behavior. The two austenitic steels come into this category and, in addition to variations in composition, differences in grain size are evident. In one instance, however, the heat-treatment was not identical.

The conditions of test selected—where a stress higher than the service stress was adopted—result in certain instances in much greater differences in creep behavior than would be expected at service stresses.

On the basis of the limited tests described in the paper, it is clear that for certain of the steels examined there is no justification for differences in stress specifications in the two countries. The major differences, which were found in the austenitic steels, are probably explained on the basis of composition and grain structure, but further work is desirable in order to study these factors with the object of achieving the highest standard of creep resistance.

A Critical Examination of Procedures Used in Britain and the United States to Determine Creep Stresses for the Design of Power Plant for Long Life at High Temperatures, by R. W. Bailey, Metropolitan-Vickers Electrical Company, Ltd. 1953 ASME Annual Meeting paper No. 53—A-196 (in print; available to Oct. 1, 1954; to be published in the *Journal of Applied Mechanics.*)

The operating life of land power plant being far longer than allowable testing time for the constructional metals, the selection of a material, or the determination of its appropriate working stress, is dependent in an important degree upon the procedure followed in utilizing the creep-test results obtained. Different procedures practiced both in Britain and in the United States can result in different views regarding the potentialities of a material, and also about the working stress allowable. This paper examines the more commonly used procedures and focuses attention upon the factors present which would operate to introduce uncertainty and error as between the probable behavior in the long time of actual service, and as yielded by a test procedure.

The principal disturbing factor in altering the resistance to creep of the material is thermal action. In some procedures, especially where the creep tests are made at working temperatures, the influence of this factor may be small or negligible in the procedure, compared with its magnitude in service. The need is emphasized for thermal action to be taken adequately into account by the test procedure. Next in importance as a possible source of error is the method of extrapolation beyond the test times to the time of the operating life.

The factor of thermal action and of its representation in the several procedures examined is considered. The circumstances of extrapolation are similarly investigated, especially in regard to whether the result would overestimate or underestimate the safe working stress.

Satisfying comparisons of working stresses using different procedures cannot at present be made. The position is therefore disappointing and one which it is desirable should be rectified.

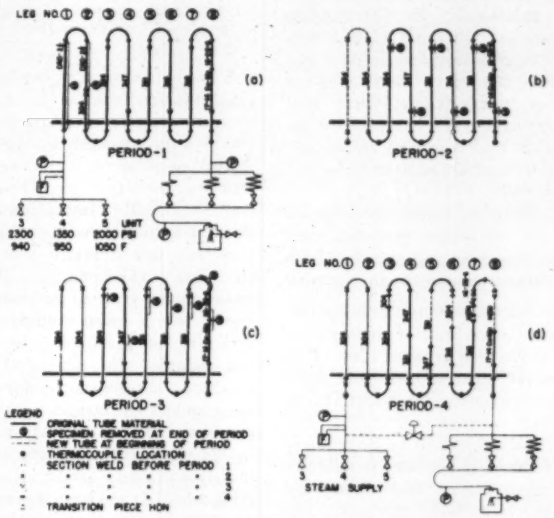
Experimental Superheater for Steam at 2000 Psi and 1250 F Progress Report After 12,000 Hr of Operation, by F. Aberle, F. G. Ely, Mem. ASME, and J. A. Dillon, The Babcock & Wilcox Co., Alliance, Ohio. 1953 ASME Annual Meeting paper No. 53—A-90 (mimeographed; available to Oct. 1, 1954).

The generation and use of steam at higher pressures and temperatures offer a direct and important means for improving power-plant cycle efficiency. Current practice is limited primarily by the materials available for construction of the high-temperature sections of superheaters and turbines and can be advanced only as new materials become available which have superior strength properties in conjunction with stability and resistance to corrosion at the higher temperatures, with the further requirement that they

be capable of commercial fabrication at reasonable cost.

Certain new alloys which were developed during and after World War II showed promising characteristics for extending steam temperatures beyond the 1050 F limit then prevailing.

In order to supplement the laboratory studies of these materials, and to obtain a practical and long-term demonstration of their suitability for superheater service, a test element was constructed. It was installed in an operating boiler at Twin Branch Plant where it could function as a small superheater, exposed to hot gases from pulverized-coal firing and receiving steam at 2000 psi, 1000 F, which, by actual heat transfer, was increased to 1250 F at the outlet of the test element.



Schematic arrangement of superheater test element for each period of operation

Field operation of this project was started in March, 1950. With certain interruptions, the test has continued successfully to the present time and shows favorable indications for eventual attainment of these steam conditions.

An account of the experience gained during the first two years of operation was presented previously by the authors. This paper deals with the succeeding two years of operation and includes preliminary information derived from metallurgical examination of a number of specimens removed from the element after approximately 7000 hr of operation.

Virtually all of the original materials are still in service in the operating element. Advantage has been taken of the opportunity to install specimens of a new experimental alloy and also to utilize the high-temperature steam produced in the system for corrosion tests of conventional superheater steels in order to extend the knowledge of the behavior of these materials.

In conclusion, the paper states that the examination of tube sections removed from the experimental superheater after 6950 hr of operation has shown that no serious impairment of essential properties has occurred in any of the seven alloys employed. Among the weld metals, 18-12 Mo and 17-14 CuMo have suffered considerable impact embrittlement. However, there is reason to believe that an improved 18-12 Mo electrode can be developed which will deposit weld metal free of dangerous embrittling tendency. An improved 17-14 CuMo electrode is already commercially available.

In view of the satisfactory behavior of the tubing materials, it may not be unrealistic to envisage the commercial use of superheaters operating with steam above 1200 F in the near future.

Boiler Feedwater Studies

Corrosion of Steel in Boilers—Attack by Dissolved Oxygen, by H. A. Grabowski, Mem. ASME, Combustion Engineering, Inc., New York, N. Y. 1953 ASME Annual Meeting paper No. **53—A-226** (mimeographed; available to Oct. 1, 1954; to be published in Trans. ASME).

A SEVERE type of corrosion, local in nature, has occurred in furnace-wall tubes in a number of intermediate and high-pressure boilers. These failures, characterized by the presence of a dark, dense layer of magnetic oxide of iron, were embrittled at the inner surface of the tube. More specifically the failures occurred at: (1) Welded areas, with and without reinforcements, at both shop and field welds; (2) away from welded areas, in straight runs of tubing; (3) at cold-worked sections, such as at bends in tubing.

The failures first occurred after operating periods from less than two months to ten years. Generally, the failures occurred after an operating period of about five to six years. The following conditions have been proposed as causing or contributing to the failures: (1) Excessive heat input; (2) inadequate circulation; (3) poor deaeration and subsequent addition of oxygen to the boiler at low loads and during outages, and (4) poor chemical control of the boiler and feedwaters and the absence of an oxygen-scavenging agent.

When failures have occurred, a further recurrence of the attack was prevented by one or several of the following items: (1) Improved deaeration, (2) addition of an oxygen scavenger, (3) minimizing the introduction of preboiler corrosion products into the boiler, and (4) adjusting boiler-water controls.

In all the cases, the paper states, a change in mechanical design to alter the furnace-wall heat pattern or fluid flow was not required for prevention of additional failures.

Experience has shown that stressed areas, as at welds or at cold-worked surfaces, are more susceptible to corrosion if adverse operating or water conditions prevail. While there is no evidence to substantiate the theory that backing rings per se will produce failures, welds without reinforcements are less susceptible to attack.

Although the exact role of oxygen is not known in the corrosion mechanism, experience has shown that failures of the nature under discussion occur where poor deaeration is known to take place. Most severe attack has been observed in units where the oxygen in the feedwater periodically is more than 0.05 ppm. The maximum amount of oxygen that can be tolerated cannot be determined from present-day information. It is believed that oxygen may be instrumental in the formation of the initial pit which leads to the accelerated corrosive action.

In view of the field investigations set forth in the paper, it is recommended that an oxygen scavenger be added to the water supplied to the boiler. The data, in general, indicate that oxygen enters the feedwater systems in quantities greater than is realized by the operating personnel during low-load, night and week-end operation.

Experimental Boiler Studies of the Breakdown of Amines, by C. Jacklin, National Aluminate Corp., Chicago, Ill. 1953 ASME Annual Meeting paper No. 53—A-240 (mimeographed; available to Oct. 1, 1954; to be published in Trans. ASME).

A REPORT of the results obtained when several types of amines were tested for breakdown to ammonia in an experimental boiler is presented. Test pressures ranged from 250 to 2500 psi and temperatures from 400 to 1200 F.

It was found that different amines showed widely different amounts of breakdown to ammonia when tested in an experimental boiler at 1500 psi and saturation temperature. Of the fifteen materials tested, cyclohexylamine, 2-diethylaminoethanol, and morpholine showed relatively low breakdown rates. Cyclohexylamine was not tested at higher temperatures because its usefulness is limited by its low solubility in the initially formed condensate in a system.

2-Diethylaminoethanol showed good stability at 1500 psi and steam temperatures up to 800 F. Above 800 F the amount of breakdown to ammonia increased rapidly.

Morpholine, in contrast, is relatively stable at boiler pressures up to 2500 psi and steam temperatures up to 1200 F. The amount of breakdown of morpholine to ammonia increases quite slowly and uniformly up to 1200 F, the highest temperature tested.

Of all the materials tested morpholine most nearly fulfills the requirements for an ideal volatile alkaline material for pH control in steam-generating systems.

Management

What Makes Automation Pay? by M. B. Millenson and J. M. Tyrner, American Machine and Foundry, New York, N. Y. 1953 ASME Annual Meeting paper No. 53—A-242 (mimeographed; available to Oct. 1, 1954).

COMPLETE automation is still restricted to a very large production and relatively static products, but partial automation has a very much wider applicability. This paper discusses some of the factors upon which the economy of automation depends.

Excluding purely military products from consideration, the decision on automation is dependent primarily on economic considerations. Some of these factors, such as a comparison of the current and potential costs of production, the additional investments required, and the change in the labor force, are relatively easy to obtain and apply generally to any case where automation is considered. Certain special factors, however, always arise in each particular case. The advertising appeal of an automatic production line may be very great in a particular product, the elimination of hazardous operations in another, and stabilization of a labor problem is still another. In the atomic energy field, for example, the health hazard to operating personnel is the overriding consideration which has led to development of automatic machinery for performing many operations. In most cases where automation is considered, however, the engineer must answer two questions for the company management. First, will the company maintain or improve its profit position in a competitive market, and second, how much additional investment is required?

The following is a summary for all situations of the major potential cost savings resulting from automation which must be balanced against the investment:

1 There is a reduction in manufacturing unit cost. The bulk of this cost reduction is a decrease in labor cost. Part of it, however, also results from more satisfactory utilization of material and fewer rejects.

2 Since the amount of labor required is greatly reduced it becomes possible to locate factories away from what are currently the large labor markets. The labor which is required becomes primarily maintenance labor, but this should not be interpreted to mean that a lower level of skill is required. The skill of the personnel responsible for maintenance of a fully automatic factory may in fact be greater than the skill level required of most of the typical machinists and other operators in a nonautomatic plant.

3 Automation may reduce cost sufficiently to warrant a large increase in total production, opening up a completely new market for the product.

In addition to these factors, there are certain special factors which arise in various instances; for example:

1 The advertising value of fully automatic plants for certain types of products is enormous. This is particularly true where it is possible to appeal to public interests in sanitary operation, as is the case with most food products, drugstore items, certain articles of clothing, and similar products.

2 An automatic factory is safer. Laborsavings may result from automation even when no reduction in the total labor force is produced merely because of lower insurance rates, compensation claims, and abnormally high wages resulting from occupational hazards.

3 In some instances, too, the size or precision of the required parts may dictate automatic production merely because there is no practical way to make any appreciable quantity by hand.

Wage-Incentive Payment for Multiple-Machine Assignments Having Planned Servicing Sequence, by Dale Jones, Georgia Institute of Technology, Atlanta, Ga. 1953 ASME Annual Meeting paper No. 53—A-215 (mimeographed; available to Oct. 1, 1954).

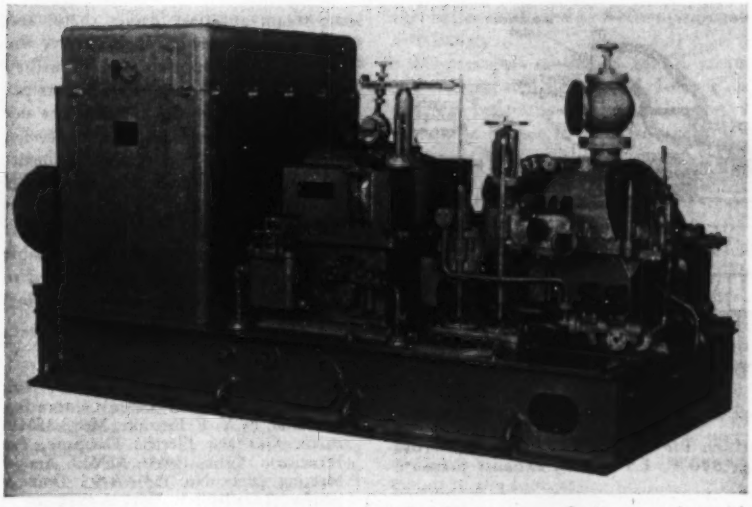
A MAJOR determinant in wage-incentive design is the number of machines the operator is assigned to tend. When the operator is engaged in repetitive, unskilled work done manually or on one machine, the wage-incentive-design problem is usually immediately solvable through conventional techniques. When, however, one operator services several machines at the same time, the design of an incentive plan to accommodate such conditions is often complex, owing to difficulty of evaluating the operator's unavoidable idle time (AIT)—due to machine automaticity—for individual assignments of various combinations of machines and/or products manufactured by the machines. It is apparent that the multiple-machine-assignment operator's AIT, which varies from one assignment to another (unless the operator is always over-assigned and therefore has no AIT), must be evaluated and compensated for on an individual assignment basis if the operator is to be granted equitable incentive pay. The evaluation and proper payment of the operator's AIT are the principal problems of multiple machine assignment incentive design.

This paper describes the operating conditions inherent in phenolic-molding activity in a department consisting of 80 employees per shift operating three shifts daily. The rules and techniques for evaluating and compensating the operators' AIT, which were recently instituted in this plant, are described.

Steam Power

Some Notes on Development of Turbine-Generator Sets for Shipboard Service, by A. G. Gale, Mem. ASME, General Electric Company, Fitchburg, Mass., and H. J. Chase, Mem. ASME, General Electric Company, Schenectady, N. Y. 1953 ASME Annual Meeting paper No. 53—A-89 (mimeographed; available to Oct. 1, 1954).

SOME of the problems encountered in designing turbine generator units for marine service are presented. Typical arrangements are shown to illustrate the trend in design to produce a unit of minimum size and weight suitable to



Turbine-generator unit for marine service showing postwar design practice with high-speed turbine. Turbine speed is 10,000 rpm, generator speed is 1200 rpm.

withstand the conditions encountered in shipboard service.

There are three controlling factors in marine practice: Installation factors, codes and specifications, and economic considerations. The most important factor is the condition imposed by motion of the vessel. This includes the rolling and pitching of a vessel in a seaway as well as the weaving and distortion of the hull structure as a foundation.

The problems arising from distortion and deflection of the hull structure, which is the foundation of the unit, must be given consideration as a potential cause of misalignment of the unit.

Concerning codes and specifications, the basic requirement is to follow the AIEE "Recommended Practices for Electric Installations on Shipboard" and to meet the American Bureau of Shipping Rules.

The plant steam conditions and heat cycle for a marine power plant are usually chosen from studies of the economics of the propulsion equipment. This establishes immediately the throttle-steam conditions for the generator-drive turbine. Since the generator unit must be in operation whether the propulsion turbine is running or not, the generator-drive turbine is connected to its own condenser and seldom is provided with extraction or back pressure features. Within this framework there is one element of value not usually considered in land practice—weight.

Weight saved in equipment for a ship may be translated into cargo capacity, particularly for tankers and ore carriers. This also applies to the weight of fuel that must be carried by the ship, which puts emphasis on good efficiency from the standpoint of minimum total weight of equipment plus fuel, as well as minimum fuel cost.

The most common arrangement of elements for a shipboard turbine-generator set to serve a 3-phase, 60-cycle, 450-volt bus consists of a relatively high-speed turbine driving a 1200-rpm generator through a single-reduction gear. This arrangement allows flexibility in design to meet various conditions of capacity and steam conditions, and for a given set of conditions almost invariably produces the best economy for minimum size and weight. Since many of the problems of installation and maintenance are reduced when minimum size and weight are achieved, this becomes a design objective having greater importance for shipboard units than for land machines.

Turbine Blade Vibration and Strength, by W. E. Trumpler, Jr., Mem. ASME, and H. M. Owens, Assoc. Mem. ASME, Westinghouse Electric Corporation, Philadelphia, Pa. 1953 ASME Annual Meeting paper No. 53—A-98 (mimeographed; available to Oct. 1, 1954).

In the design of turbines, the strength of the blades is a matter of great importance since blading is the heart of the turbine. This paper discusses the factors which affect the strength of turbine blades and shows what recent progress has been made and what studies are under way toward improved blade designs. The discussion is limited to the full-admission type of blade row which is subjected to steam flow through its full annulus, the most common type of blade row.

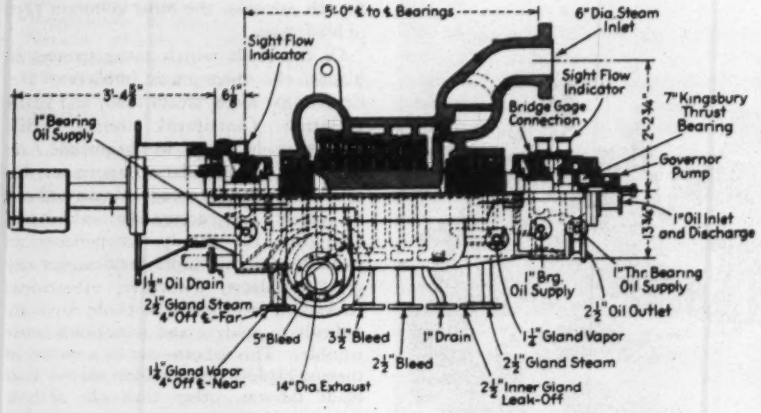
Of the loads which cause stresses in blades, the three most important are: Centrifugal force, steam load, and blade vibration. Centrifugal stresses, while they may be large in magnitude, are relatively of secondary importance because they are of a steady nature and can be easily and accurately calculated. Similarly, the steady components of steam load do not cause the designer any great problems. However, vibrational stresses in full-admission blade rows are difficult to analyze and sometimes cause trouble. This is borne out by a review of turbine-blade history which shows that blade failures, other than the fatigue type, rarely occur.

Vibrational stresses cannot be calculated accurately because of the almost intangible nature of two important factors, excitation and vibratory build-up. The first of these, excitation, is the magnitude of the periodic forces that can cause vibrations. The vibratory build-up is the amplitude of vibration or response of a blade group to this excitation. Nearly all blade vibrations are excited by the steam within the turbine, but in some cases external disturbances do set up exciting forces. In marine applications, the turbine-gear-propellor systems sometimes develop strong torsional oscillations which are impressed on the blading. These do not cause blading troubles, however, for their frequencies are so low that no resonant blade vibrations can arise. Excitating forces of higher frequencies occasionally are set up by imperfect teeth in the reduction gears but these are effectively isolated from the turbine blading by the flexible shafts which are used to insure proper gear alignment.

The predominant source of excitation of steam-turbine blade vibrations is the steam itself. Ideally, steam flow in 100 per cent admission stages is uniform but practically many structural features of the turbine cause flow variations.

Comparison of Land and Marine Steam-Power-Plant Practice, by Mark L. Ireland, Jr., Mem. ASME, Newport News Shipbuilding & Drydock Co., Newport News, Va., Frank A. Ritchings, Assoc. Mem. ASME, and Sabin Crocker, Fellow ASME, Ebasco Services, Inc., New York, N. Y. 1953 ASME Annual Meeting paper No. 53—A-99 (mimeographed; available to Oct. 1, 1954).

The paper shows that the economic incentives influencing rate of progress are quite different for land and marine plants, even of the same size, and vary widely for different types of ships.



Longitudinal section of high-pressure turbine for 10-mw or 13,750-hp cross-compound marine power plant; 840 psig, 840 F, 1.5 in. Hg exhaust pressure

However, the modern tanker, when making a long haul, appears to have at least as much incentive to improve fuel performance as power stations of the same unit rating.

It is shown that in relation to their inherent sizes and load factors modern marine power plants use steam conditions and plant-cycle arrangements which are equivalent to their shore-based counterparts.

A detailed consideration is given to prime movers, steam generators, plant cycles, and components. In each case an effort is made to account for differences in performance and practice.

Considering first the economics of public-utility stations, a larger plant will be more efficient and produce electricity at less cost. Therefore, utility plants are designed to use the largest units that system requirements will permit. The same is true of modern marine power plants in the sense that owners commonly select the largest ships suitable for their docking and cargo-handling facilities. The size of a ship's power plant then is a function of speed which is a basic factor in marine power-plant economics having no counterpart in land plants. Unfortunately, driving power varies from the third to fifth power of speed so that minimum ship transportation cost is usually reached at unit ratings which are at the low end of the land-plant scale.

There is a greater difference between land and marine steam-generating units than is found with any other single item of major equipment. Land units usually are designed for greater static head, larger tube diameters, closer water-wall tube spacing, larger furnace volume, lesser heat release, lesser heat available, greater burner spacing, etc., than is the case with marine design. Marine design is dictated to a greater extent by space considerations.

Normal evaporative ratings for merchant-marine boilers range from 50,000 to 100,000 lb of steam per hr while land boilers of comparable design features usually range from 100,000 to 200,000 lb per hr. Apart from their larger capacity ratings, land boilers for steam conditions exceeding about 1350 psi and 950 F are not directly comparable with marine units because of a quite different distribution of heat absorption, particularly where reheat is used.

Quick starting and maneuvering with marine boilers and turbines pose much the same problems as with quick starting and sudden load swings in land stations. Both utilize turning gears for slowly revolving the turbine rotor in starting and shutting down, and for stand-by during brief reserve periods. The existence of two or more boilers per turbine unit on shipboard interposes different starting-up conditions than obtain in a "unit-system" plant on land. One boiler of the marine installation is normally in operation at partial load to supply electrical generation, steam pumps, and ship services before getting underway, whereas a land boiler-turbine unit has to come up together.

A review of the similarities and differences between land and marine power plants indicates that there are no outstanding differences in basic viewpoints, procedures, or results within the limitations naturally defined for each field. There are, of course, differences due to varying aspects of similar problems and some variations due to the gradual nature of technical evolution. Such differences as do exist are largely because of space limitations aboard ship, the use of some steam auxiliary drives there, and freedom to use turbine speeds above the 3600-rpm synchronous speed of utility plants. The presence of two boilers per ship coupled with the intermittent use of its propulsion equipment between layover periods in port permits frequent, though brief, shutdowns of one boiler at a time for maintenance. This makes it feasible to operate marine boilers at higher heat-release rates than are possible with utility boilers that are expected to operate continuously for a year at a time.

Manpower and Other Factors Affecting Operating Costs in Steam Generating Stations, by V. F. Estcourt, Mem. ASME, Pacific Gas and Electric Company, San Francisco, Calif. 1953 ASME Annual Meeting paper No. 53—A-95 (mimeographed; available to Oct. 1, 1954; to be published in Trans. ASME).

THE tremendous gains in thermal efficiency which have been achieved by going to higher steam pressures and temperatures with increasingly larger units are now approaching a point where the returns are diminishing at an impressive rate. As these rates of improvement continue to diminish with still further increases in temperature and pressure, it becomes increasingly important to give closer attention to the effect of basic plant design upon the total station payroll.

Various philosophies of centralized control are reviewed and evaluated in some detail. The interrelation between design and operating concepts is reviewed, and the effect of plant management policies upon operating costs is discussed.

It is shown that many of these problems are adaptable to economic evaluation and the need for such an approach is greatly emphasized in the light of the present trend of technological advances and changing economic conditions. The effect of the changing requirements in the type of plant operating organization is also discussed in relation to the control of operating costs.

The Controlled-Circulation Boiler, by W. H. Armacost, Fellow ASME, Combustion Engineering, Inc., New York, N. Y. 1953 ASME Annual Meeting paper No. 53—A-91 (mimeographed; available to Oct. 1, 1954; to be published in Trans. ASME).

FROM the standpoint of circulation there are two general types of boilers in operation in this country. These are natural circulation based on the conventional "thermal circulation head," and controlled circulation based on the use of

a pump to distribute and circulate the water through the heat-absorption areas. With the trend toward larger high-pressure units, industry is directing more and more attention to the controlled-circulation type. Therefore, it appears desirable to summarize the information regarding these boilers. This paper deals largely with (*a*) the development of these boilers, (*b*) presently preferred designs, (*c*) operating features, results, and characteristics, and (*d*) brief reference to installations in this country.

Controlled Circulation at Chesterfield, by T. E. Crossan, Mem. ASME, Virginia Electric and Power Company, Richmond, Va., and W. F. Ryan, Fellow ASME, Stone & Webster Engineering Corp., Boston, Mass. 1953 ASME Annual Meeting paper No. **53—A-96** (mimeographed; available to Oct. 1, 1954; to be published in Trans. ASME).

THE controlled-circulation boiler installed at the Chesterfield Station is rated at 750,000 lb of steam per hr at 1500 psig, 1000 F initial steam temperature, and 1000 F reheat.

The boiler and 100-mw turbine generator first supplied energy to the Virginia Electric and Power Company system on Nov. 9, 1952, and were in commercial operation as of Dec. 1. Since the latter date, two outages have occurred, one forced and one scheduled.

As of Sept. 3, the unit had been in continuous operation since Feb. 4, 1953. Loading of the unit varies from 35 to 110 mw. Normal load is 105 mw from 12 to 18 hr per day, dropping to a minimum of 35 mw during the early morning hours as dictated by system conditions. Availability of the unit since Dec. 1, 1952, has been about 98.5 per cent. Operation of the boiler to date has been more than satisfactory.

Maintenance of design initial steam and reheat temperature of 1000 F is achieved by means of the combination of automatic burner tilt control and spray attemperation, with variations normally of about 5 F and not exceeding 10 F at outputs above about 550,000 lb of steam per hr.

All concerned are thoroughly satisfied with the choice of controlled circulation for Chesterfield; management, because of the low initial cost and dependable capacity, and plant personnel because of the freedom from operating difficulties. Confidence in the selection of controlled-circulation boilers is further reflected in the decision to install three more units of this design to meet future system demands of the company.

The Economics of Large Reheat Turbine Exhaust End Size Selection, by D. W. R. Morgan, Jr., Assoc. Mem. ASME, and S. D. Fulton, Mem. ASME, Westinghouse Electric Corporation, Philadelphia, Pa. 1953 ASME Annual Meeting paper No. **53—A-93** (mimeographed; available to Oct. 1, 1954; to be published in Trans. ASME).

THIS paper provides a method and tools for making a study, at capability performance, of large reheat steam turbine exhaust end size, and of those other plant components which are affected by the heat rejected to the condenser. The result of this type of study will lead to an economic evaluation and selection of appropriate turbine exhaust ends.

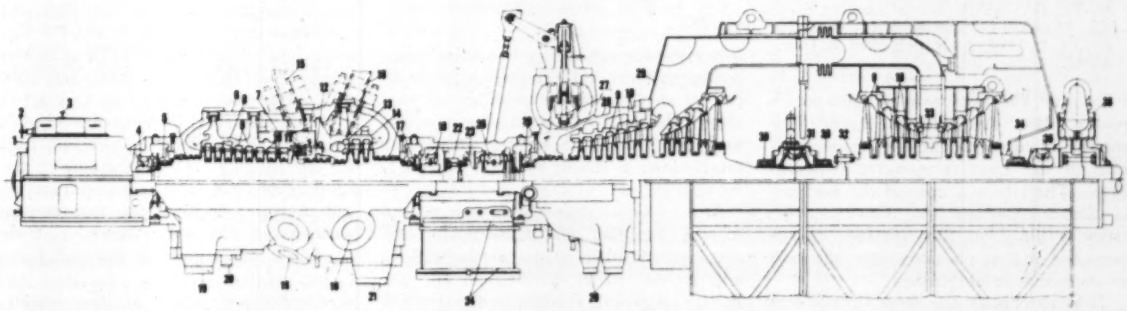
It is often desirable to investigate the effect on over-all plant performance and gross cost of operation, including investment and fixed charges, of the various turbine exhaust stage annuli available on alternative units of large ratings. This paper does not attempt to provide exact or final answers, but measures principal factors and indicates whether a given situation warrants a more detailed study.

The method presented for the evaluation of the relative economy of the various sizes of exhaust end annuli requires a minimum amount of data for the preparation of a preliminary analysis. However, a degree of accuracy is obtainable which is sufficient to define the areas requiring a more detailed analysis. In many cases no further study will be required.

The effect of partial loads, reduced vacuums in summer months, and increased building and foundation costs, are all items which will make the larger size exhaust end less attractive. Therefore, any situation which does not appear economically feasible from an analysis made by the method outlined in this paper is unlikely to warrant a more detailed study.

Reheat Turbines at Chesterfield and Kearny Stations, by C. W. Elston, Mem. ASME, General Electric Company, Schenectady, N. Y. 1953 ASME Annual Meeting paper No. **53—A-92** (mimeographed; available to Oct. 1, 1954).

SINCE 1948 the growth in popularity of the reheat cycle for central-station power generation has been phenomenally rapid. Ninety-two per cent of the turbine-generator capacity scheduled for shipment by General Electric in 1954 is being built for the reheat cycle. The maximum rating of reheat turbines now on order ranges from 56,000 kw to 260,000 kw. Most of these units with maximum ratings of 200,000 kw or less are 3600-rpm tandem-compound turbines,



Longitudinal cross section of No. 7 turbine Kearny Station. 1, Turbine-end standard and cap; 2, handwheel control; 3, governor synchronizing wheel; 4, journal bearing; 5, steam packing; 6, outer shell; 7, inner shell; 8, inner shell; 9, stage diaphragms; 10, stage buckets; 11, nozzle; 12, steam packing; 13, reheat nozzle; 14, inner shell; 15, main steam inlet; 16, reheat steam inlet; 17, steam packing; 18, journal bearing; 19, steam exhaust; 20, stage extractions; 21, steam exhaust; 22, rotor; 23, rotor; 24, turbine-middle standard and base; 25, journal and thrust bearing; 26, steam packing; 27, intercept valve; 28, outer shell; 29, exhaust hood; 30, steam packing; 31, journal bearing; 32, rotor; 33, nozzle; 34, steam packing; 35, journal bearing; and 36, turning gear. Max. rating, 145,000 kw; 2350 psig; 1100 F initial, and 1050 F reheat; 1½ in. Hg exhaust.

while, with one exception, all the units above 200,000 kw maximum rating are of the cross-compound type.

This paper deals with three 3600-rpm tandem-compound turbines that have gone into service during the past year: (1) The 90,000-kw ASME-AIEE preferred standard reheat unit at the Chesterfield Station of Virginia Electric and Power Company, and (2) the two 145-000-kw tandem-compound triple-flow reheat turbines at the Kearny Station of Public Service Electric and Gas Co., New Jersey.

Unit No. 3 at the Chesterfield Station is a typical opposed-flow tandem-compound double-flow reheat turbine with a maximum rating of 99,000 kw and designed for 1450-psig, 1000-F initial steam conditions, 1000-F reheat temperature, and $1^1/_2$-in. Hg absolute exhaust pressure.

Units No. 7 and No. 8 at the Kearny Station are 3600-rpm tandem-compound triple-flow reheat turbines with a maximum rating of 145,000 kw and designed for 2350-psig, 1100-F initial steam conditions, 1050-F reheat temperature, and $1^1/_2$-in. Hg absolute exhaust pressure. The No. 7 unit went into service in April, 1953, and No. 8 in November, 1953.

The Chesterfield unit is about representative of the "average" reheat turbine with respect to rating and steam conditions. Conversely, the Kearny units are representative of "advanced design." In addition to being the first 1100-F turbines, they were, at the time that the first Kearny unit went into service, the largest 3600-rpm tandem-compound turbines.

Economic Determination of Condenser and Turbine-Exhaust Sizes, by E. H. Miller, Assoc. Mem. ASME, General Electric Company, Schenectady, N. Y., and A. Sidun, Foster Wheeler Corporation, New York, N. Y. 1953 ASME Annual Meeting paper No. 53—A-94 (mimeographed; available to Oct. 1, 1954; to be published in Trans. ASME).

IDEALLY, the pressure at which a steam power plant exhausts its steam flow should be equal to the saturation pressure of the circulating-water temperature. The size and cost of the turbine-condenser combination, however, increase rapidly as this pressure is approached and, at the same time, the gain in performance diminishes.

Thus to choose the most economical combination of turbine and condenser in a practical case, the point must be determined where the additional investment due to larger condensers and a larger turbine-exhaust area can no longer be economically balanced by an improvement in station performance. The method of finding this economic balance point can logically be separated into three parts:

1 Find the difference in station performance between combinations.

2 Find the difference in station costs between combinations.

3 Place a dollar value on the differences in station performance and compare this value with differences in cost.

Each of these three problems is covered in detail in this paper. In addition, an example showing the use of this method has been included.

A Short Method for the Evaluation of the Effect of Some Thermal-Cycle Variations on Steam-Turbine Heat Rates, by S. D. Fulton, Mem. ASME, Westinghouse Electric Corporation, Philadelphia, Pa. 1953 ASME Annual Meeting paper No. 53—A-97 (mimeographed; available to Oct. 1, 1954; to be published in Trans. ASME).

THIS paper presents a short method of evaluating the effect of several thermal-cycle variations on steam-turbine heat rates, utilizing the data given in a heat balance. The method is based on the fact that the product of the input to a cycle and its thermal efficiency equals the output. To use this fact a method for determining the thermal efficiency from any extraction point to the turbine exhaust is presented. Equations derived for the various changes in the cycle make determination of heat-rate changes very simple. A high order of accuracy is obtained by computing only the changes in the input and output.

Piping Flexibility Analysis, by A. R. C. Markl, Tube Turns, Inc., Louisville, Ky. 1953 ASME Annual Meeting paper No. 53—A-51 (mimeographed; available to Oct. 1, 1954; to be published in Trans. ASME).

A STEADILY expanding literature bears testimony to the growing recognition of the importance of the problem of providing flexibility in piping and to the many difficulties besetting efforts at establishing a simple rational approach for its solution.

This paper outlines the various phases of the problem. It particularly emphasizes the phenomena of plastic flow and fatigue which distinguish the behavior of piping systems under thermal expansion from the ordinary room-temperature steady-state structural problem and leads to the concept of a limiting-stress range rather than an allowable stress as the criterion of the adequacy of a layout.

The paper attempts to present the consensus of the Task Force on Flexibility charged with reformulating Chapter 3 of Section 6 of the Code for Pressure Piping. Their Proposed Rules are included as a focal point on which it is hoped broad discussion will center.

In-Plane Bending Properties of Welding Elbows, by P. L. Vissat, Taylor Forge & Pipe Works, Chicago, Ill., and A. J. Del Buono, Taylor Forge & Pipe Works, New York, N. Y. 1953 ASME Annual Meeting paper No. 53—A-70 (mimeographed; available to Oct. 1, 1954; to be published in Trans. ASME).

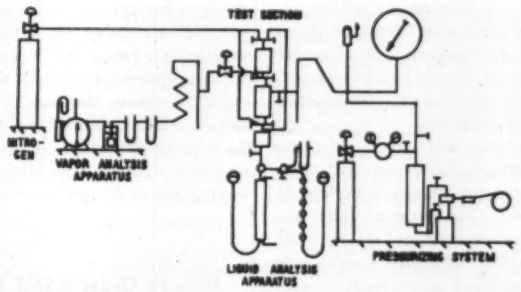
THIS paper presents results of strain gage investigations conducted on relatively heavy wall WeldELLS® having a ratio of bend radius to nominal pipe size of $1^1/_2$:1. Also, several WeldELLS having a ratio of bend radius to nominal pipe size of 1:1 were tested. A comparison is made of the results against theory. Design factors for WeldELLS are established and tabulated.

The Solubility of Nitrogen and Hydrogen in Water, by S. N. Suciu, Assoc. Mem. ASME, General Electric Company, Lockland, Ohio, L. M. Zoss, Taylor Instrument Company, Rochester, N. Y., and W. L. Sibbitt, Assoc. Mem. ASME, Purdue University, Lafayette, Ind. 1953 ASME Annual Meeting paper No. 53—A-64 (mimeographed; available to Oct. 1, 1954).

THE solubility of gases in water is of interest to designers and operators of steam generators, hot-water heaters, nitrogen fixation plants, and the like, and to students of theoretical thermodynamics.

An apparatus was constructed for obtaining phase equilibrium data up to 10,000 psia and 750 F. The solubility of nitrogen in water was measured at 500, 1000, 1500, 2000, and 3000 psia, and at temperatures from 32 to 500 F. The solubility of hydrogen in water was measured at 1000, 1500, 2000, and 3000 psia, and at temperatures from 32 to 635 F.

The fundamental problems involved in obtaining valid phase equilibrium data are as follows: (1) Obtaining phase equilibrium (at constant temperature and pressure) between the various constituents in the two phases; (2) obtaining a true sample of the liquid and vapor phases without changing the thermodynamic state of the system. The apparatus which was developed for this investigation consisted of a high-pressure vessel with integral vapor and liquid sample chambers, heaters, temperature controls, rocking mechanism, auxiliary pumps, pressure controls, re-



Flow diagram of complete system for obtaining solubility of gases in water

cording instruments, and analytical equipment.

The data show that Henry's Law does not hold at pressures much above 1000 psia, the paper states.

The method, which does not include the assumption of Henry's Law developed by Krichevsky, et al., for correlating solubility data, gives good agreement for the special case of slightly soluble gases in solvents with small vapor pressures. This method of correlation gives the most accurate extrapolation of low-pressure measurements to high pressures. In order to apply this method, it is necessary to know the fugacity of the gaseous constituent and the mol fraction of the gaseous constituent in the vapor phase. Accurate data of this type are not generally available.

A large quantity of accurate data on gas solubilities are now available. However, the general solubility relations cannot be resolved until data of very high accuracy are obtained for the density of both the vapor and liquid phases at high temperatures and pressures.

Flue-Gas Corrosion

The Influence of Fine Particles on the Corrosion of Economizer and Air Preheater Surfaces by Flue Gases, by Peter Hodson, The Air Preheater Corporation, Wellsville, N. Y. 1953 ASME Annual Meeting paper No. 53—A-232 (mimeographed; available to Oct. 1, 1954; to be published in Trans. ASME).

Fine particles are those less than 10 microns in diameter and are often not detected as single particles by a light microscope. They have a large relative surface area which tends to accelerate any reaction as well as increasing their ability to adsorb another substance. Flue-gas corrosion is caused by sulphur compounds and water vapor forming sulphuric acid which attacks iron to form ferric and ferrous sulphate. The former is a catalyst in the formation of sulphur trioxide from sulphur dioxide. Sulphur trioxide and ferric sulphate also raise the dew point. Fine particles consist of unburned fuel and ash spheres known as cenospheres or fragments of the latter. They increase the reaction rate as well as the condensation temperature and rate. They can attain a temperature lower than that of the gas stream by radiation and are good condensation nuclei.

A qualitative test of the formation temperature, extent and nature of deposits from cleaned and dirty gas showed that deposits tend to build up in a narrow range and that cleaning the gas greatly decreases the rate of deposit build-up.

The Use of Additives for the Prevention of Low-Temperature Corrosion in Oil-Fired Steam-Generating Units, by E. C. Huge, Mem. ASME, and Edward C. Piotter, The Babcock & Wilcox Company, Alliance, Ohio. 1953 ASME Annual Meeting paper No. 53—A-235 (mimeographed; available to Oct. 1, 1954; to be published in Trans. ASME).

Low-Temperature corrosion has become an important consideration and presents a real problem in the design and operation of oil-fired steam-generating units. It is caused by the presence of sulphur trioxide in the combustion gases which unites with water vapor and forms sulphuric acid on the cooler surfaces of the unit. Various ways of combating this condition are discussed, with particular emphasis on the use of dolomite as an additive. Test data and the results of actual operating experience are presented which show that additives are effective in reducing the amount of acid formed and, in some cases, practically eliminating cold-end pluggage and corrosion. The economics of their use and the design of units for higher efficiency when using additives are also discussed.

The following conclusions were reached:

1 All boilers which burn sulphur-bearing fuels will produce some sulphur trioxide which combines with the water vapor in the flue gases to produce sulphuric acid.

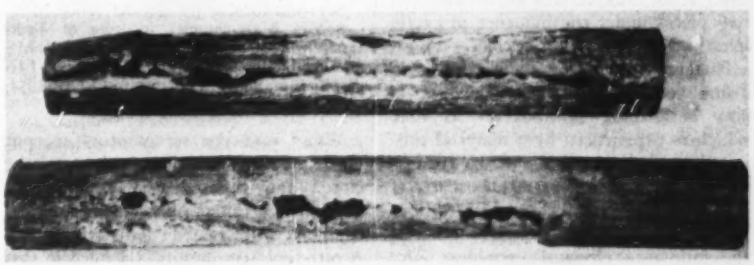
The amount of corrosion in a specific unit depends primarily on the relationship of metal temperatures to the dew-point temperature of the flue gases and the balance between the sulphuric acid condensing and the quantity of basic ash constituents.

2 Residual oil fuel is comparatively high in sulphur and its ash frequently contains a high proportion of constituents which may promote the formation of sulphur trioxide. In addition, oil ash contains limited quantities of materials which will absorb sulphur trioxide or neutralize sulphuric acid. For this reason, the combustion gases from most residual oils are considered potentially corrosive.

3 The use of an additive, such as dolomite, will reduce the amount of sulphur trioxide present in the flue gases and will inhibit sulphuric-acid corrosion Furthermore, dolomite will reduce the quantity of ash depositing in the air heater and the amount of work necessary to keep these surfaces clean.

4 The use of dolomite for the prevention of low-temperature corrosion is economically feasible and it is recommended where corrosion or pluggage is a problem.

It is anticipated that it will be possible to further lower exit-gas temperatures and realize gains in boiler efficiency which were heretofore denied because of prohibitive corrosion conditions.



Examples of air-heater tube failures because of corrosion; less than a year's service

Machine Design

Synthesis of the Quadric Chain When the Position of Two Members Is Prescribed, by B. W. Shaffer, Assoc. Mem. ASME, and I. Cochin, New York University, New York, N. Y. 1953 ASME Annual Meeting paper No. 53—A-144 (mimeographed; available to Oct. 1, 1954; to be published in Trans. ASME).

THE problem considered in this paper is the design of a four-bar mechanism, or quadric chain as it is sometimes called, in which the position of the follower arm is related to the position of the driving arm in a prescribed manner. The four-bar mechanism is analyzed, and a differential equation is derived which tells whether or not it is possible to find a particular design in which the position of the driver and follower are related in a prescribed manner during the entire range of operation. If there is such a mechanism, the length required for each of the links may be found by substituting into the appropriate equations, also derived in this paper.

A Concept of Fatigue Damage, by S. M. Marco, Assoc. Mem. ASME, and W. L. Starkey, Assoc. Mem. ASME, The Ohio State University, Columbus, Ohio. 1953 ASME Annual Meeting paper No. 53—A-143 (mimeographed; available to Oct. 1, 1954; to be published in Trans. ASME).

THE study of fatigue damage to machine parts involves many complex problems, one of which is the development of theories and procedures for laboratory tests of specimens which would duplicate the variable stresses a machine is subjected to in service. Previous investigations have fostered several theories of damage failure based on laboratory tests which applied a sequence of stress cycles of different amplitudes to single specimens until failure was accomplished. Some of these concepts of damage assume that the sum of cycle ratios for the various stress levels used should be unity. In this paper, the authors propose that fatigue damage be represented by zero when no cyclic-stress history exists in a specimen, and unity when the specimen has broken into two pieces under the influence of cyclic stressing.

Fatigue damage is a difficult term to define precisely or quantitatively. It may be defined qualitatively as that which is experienced by a material subjected to cyclic stressing which reduces the number of cycles of stress the material will yet withstand before final failure. Fatigue damage is probably a function of the following physical variables: The number of independent fatigue nuclei or progressive-fracture cracks which are operative, the sizes and shapes of these cracks, the cold-working effect on the material adjacent to the crack surfaces, and a possible thermal-recrystallization effect in the same material.

All fatigue tests were made on three Krouse rotating-cantilever-beam machines having maximum operating speeds of 10,000 rpm. One series of tests was conducted with specimens of 76 S-T61 aluminum alloy. Another series of tests was conducted with specimens of SAE 4340 steel alloy. The steel specimens were heat-treated to within the Rockwell hardness range C28 to C32. Great care was exercised in the roughing, finish turning, and polishing operations. The final polish marks were parallel to the axis of the specimen. The roughness of the final surface was of the order of 4 microin. Tests of hardness, yield point, and ultimate strength were conducted to control the properties of the specimens used in the investigations.

Linkage Design, a Note on One Method, by A. S. Hall, Mem. ASME, Purdue University, Lafayette, Ind., and D. C. Tao, Portage Machine Company, Akron, Ohio. 1953 ASME Annual Meeting paper No. 53—A-142 (mimeographed; available to Oct. 1, 1954; to be published in Trans. ASME).

FOR a large class of problems in the size synthesis of linkages the desired kinematic performance of the linkage to be designed can be reduced to a functional relation between the displacements of the output and input links.

A graphical procedure, using velocity-vector diagrams, is suggested in this paper for determining the coefficients $\partial S/\partial p_n$, where S represents the output displacement of a linkage and p_n are parameters (dimensions) of the linkage. These coefficients appear in a design procedure used by Svoboda on the four-bar linkage. It is suggested that his procedure may prove useful in the design of more complex linkages.

Proportional Control of Rate-Type Servomotors, by J. L. Shearer, Assoc. Mem. ASME, Massachusetts Institute of Technology, Cambridge, Mass. 1953 ASME Annual Meeting paper No. 53—A-146 (mimeographed; available to Oct. 1, 1954; to be published in Trans. ASME).

WHEN rate-type servomotors are put under proportional control, the resulting closed-loop systems may become unstable when the amount of proportional control is increased indiscriminately. A rate-type servomotor is defined in this paper as a servomotor with a rate of change of output proportional to the input during steady-state operation. It is usually advantageous to introduce as much proportional control as possible in order to obtain the fastest speed of response. More elaborate means of control may be employed to improve speed of response without sacrificing system stability, but it is important to know first

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what performance may be attained with simple proportional control. Recent work by the author on hydraulic control systems revealed the need of understanding thoroughly the performance of rate-type servomotors having second-order lag effects when under proportional control. A high-speed electronic-analog computer proved to be a satisfactory means of gaining this understanding for various types of second-order lag effects.

Optimum proportional control of various kinds of rate-type servomotors having second-order lag effects has been determined by means of an electronic-analog study. The results of this study, presented in the form of nondimensional graphs, establish the conditions for obtaining the fastest closed-loop response with no overshoot and closed-loop response with 20 per cent overshoot. Information relating to the speed of response associated with optimum control also is given graphically. It is shown that the results of this work may be applied likewise to the floating control of second-order processes.

Dynamic Characteristics of Valve-Controlled Hydraulic Servomotors, by J. L. Shearer, Assoc. Mem. ASME, Massachusetts Institute of Technology, Cambridge, Mass. 1953 ASME Annual Meeting paper No. **53—A-147** (mimeographed; available to Oct. 1, 1954; to be published in Trans. ASME).

Experience has shown that when the mass on the output shaft of a valve-controlled servomotor is sufficiently large, the effect of fluid compressibility and elasticity of fluid lines play an important role in system performance. As industrial and military requirements have created a demand for faster, stable systems capable of driving massive loads, the problems associated with the compliant nature of the coupling between valve and motor have grown. Recent work in the dynamic analysis and control laboratory and in the department of mechanical engineering at M.I.T. with flow-valve characteristics and the simulation of dynamic systems had led to a better understanding of the dynamic behavior of systems employing valve-controlled servomotors. Experience has shown that it is important to understand thoroughly the characteristics of the servomotor and its load in order to incorporate the servomotor successfully into more complex systems. A four-way valve and a ram-type motor are the hydraulic components analyzed in this paper. The fundamental concepts developed are common to servomotors employing either three-way or four-way valves and either linear or rotary motors.

A servomotor consisting of a valve-controlled ram connected to a mass-plus-viscous friction load is analyzed on the basis of its response to small changes of valve position and external load force. The approach is sufficiently general to enable a person to deal effectively with systems in which fluid compressibility is an important factor. At the same time, this approach is helpful in working with simpler systems. A functional block diagram is employed to delineate symbolically the significance of each system characteristic.

Availability List of Unpublished ASME Papers

A Number of papers and reports were presented at ASME Meetings which were neither preprinted nor published. Manuscript copies of these papers are on file for reference purposes in the Engineering Societies Library, 29 West 39th St., New York 18, N. Y. Photostatic copies of these unpublished papers may be secured from the Library at the rate of 40 cents per page. The following papers recently have been placed on file in the Engineering Societies Library:

1953 ASME Annual Meeting

The Use of Oscillographs and Similar Instruments in Analysis of Machinery Operations, by A. Palmer and V. Sepavich

Speedylectric, The Electrode Boiler: A New Method of Supplying Heat to Calenders and Platens, by B. C. Higgins

Drive Requirements for Cotton Machinery, by Z. S. Szaloki

Operating Experience With a 14,000-Ton Capacity Hydraulic Extrusion Press, by C. R. Anderson

On-the-Job Training, by W. R. Thompson

What Textile Preparatory Machinery Needs Variable-Speed Drives and Why, by J. L. Delaney

Industrial Applications of Linear Programming, by R. O. Ferguson

Economic Problems of the Automatic Factory, by E. M. Hicks

Modern Rubber Calendering Equipment, by N. J. Elder

Trouble Shooting for Quality, by R. C. Miles

Fuel Resources in the Future Use of Energy, by L. C. McCabe.

Laboratory and Field Experience With Heating Oils, by R. P. Gilmartin

Emphasizing Safety in a Crowded Engineering Curriculum, by Jesse Huckert

Modern Co-Operative Sawmill Operation For High Yields, by F. T. Parrish

Super-Refrigeration, by R. J. Sweeney

Organized for Safety, by C. D. Moore

Training Men to Cut Costs, by H. N. Meixner

1953 ASME Fall Meeting

A Survey of Columns, by E. W. Neben

Design Considerations of Vacuum Systems Based on the Oil-Vapor Ejector-Type Vacuum Pump, by G. P. Gerow

The Engineer and His Community, by C. H. Brown

ASME Transactions for April, 1954

The April, 1954, issue of the Transactions of the ASME (available at $1 per copy to ASME members; $1.50 to nonmembers) contains the following:

Technical Papers

A New Type of Radiant Tubular Heater, by T. F. Kreipe. (53—SA-40)

Study of Cubic Characteristic Equation by Root-Locus Method, by Yaohan Chu and V. C. M. Yeh. (53—F-21)

The Study of Transients in Linear Feedback System by Conformal Mapping and the Root-Locus Method, by V. C. M. Yeh. (53—F-7)

Static Flow Characteristics of Single and Two-Stage Spring-Loaded Gas Pressure Regulators, by A. S. Iberall. (53—F-5)

Properties of Residual Petroleum Fuels, by W. Sacks. (53—F-1)

Mechanical Aspects of Seizing in Metal Wear, by Harry Czyzewski. (53—SA-26)

Heat-Transfer and Friction Characteristics for Gas Flow Normal to Tube Banks—Use of a Transient-Test Technique, by W. M. Kays, A. L. London, and R. K. Lo.

Erosion by Melting and Evaporation, by Kurt Berman. (53—F-2)

Rapid Measurements of Thermal Diffusivity, by C. E. McIntosh, D. C. Hamilton, and W. L. Sibbitt. (53—F-3)

Thermal Lags in Flowing Systems Containing Heat Capacitors, by J. W. Rizika. (53—F-8)

Calculation of Transient Temperatures in Pipes and Heat Exchangers by Numerical Methods, by G. M. Dusinberre. (53—F-6)

A Wall-Thickness Formula for High-Pressure, High-Temperature Piping, by W. R. Burrows, R. Michel, and A. W. Rankin. (52—A-151)

Effect of Exhaust Pressure on the Economy of Condensing Turbines, by A. Keller and J. E. Downs. (53—SA-73)

The Development of High-Output Free-Piston Gas Generators, by R. A. Lasley and F. M. Lewis. (53—S-34)

Experimental Investigations of Propagating Stall in Axial-Flow Compressors, by T. Iura and W. D. Rannie. (53—SA-69)

Basic Compressor Characteristics From Tests of a Two-Stage Axial-Flow Machine, by W. R. New, A. H. Redding, H. B. Saldin, and K. O. Fentress. (53—A-205)

An Analytical Approach to the Design of Four-Link Mechanisms, by Ferdinand Freudenstein. (53—F-10)

Minimization of Gear-Train Inertia, by E. G. Burgess, Jr. (53—F-13)

Comments on Papers

Including Letters From Readers on Miscellaneous Subjects

Prestressed Concrete

Comment by M. Fornerod[1]

The writer wishes to congratulate the authors for their excellent presentation[2] of basic principles and of construction methods in the field of prestressed concrete and particularly of the construction of liquid containers.

The paper gives a well-rounded picture of the many technical and economical advantages which prestressing offers to the petroleum industry, and which, until now, have not received the attention they deserve. While over 600 prestressed tanks for water and for industrial use have been built, their use in the petroleum industry has been handicapped, as described by the authors, by the lining problem for lighter stocks and for aviation gasoline. Many heavy-fuel-oil tanks are in successful operation with only a sodium-silicate spray application on the inside surface. The writer wishes to emphasize that research in the lining field has been very active and that, together with the latest improvements in design and technique of prestressing, we can look forward to a rapidly increasing use of this type of construction in the petroleum industry and for special storage problems in industry, in general.

It may be of interest that, as a result of these developments, many special problems were met successfully, as for instance, the storage in prestressed-concrete tanks of liquid oxygen and the storage of waste radioactive material.

The trend in the design of prestressed-concrete storage tanks is to reappraise all factors affecting operation and safety against fire hazard. This includes vulnerability to air attack and possibilities for camouflage by backfill or underground construction. Close co-operation between the plant engineers and the structural engineer in the planning of storage facilities is therefore of prime importance. The possibilities offered in this respect by prestressed-concrete construction are aptly demonstrated by the authors' presentation.

[1] Chief Engineer, The Preload Company, Inc., New York, N. Y.

[2] "Why Prestressed Concrete in the Refinery," by J. S. Bell and D. R. Deveaux, MECHANICAL ENGINEERING, vol. 75, December, 1953, pp. 970–974.

High-Speed Weighing

Comment by John A. Hrones[3]

The high-speed weighing machine described in a recent paper[4] is an interesting design which appears to have real promise. To interpret the rather unconventional presentation, the following analysis may be of some help. Fig. 1 of this comment shows the system prior to weighing with the package on the scale and system locked. In Fig. 2, the forces acting on the float are shown for this condition. If the weight W is less than the initial lockup force F_L, the float does not move when the lock is released. If, however, the weight W exceeds the initial lockup force F_L, upon release the float is subjected to the step force shown in Fig. 3. It is shown in a displaced position in Fig. 4.

In the lockup position before the package is on the scale, the following equation holds

$$W_T + F_L = F_B \quad \ldots\ldots [1]$$

After release the following relationship is valid

$$F_L + W_T + (W - F_L) = F + \frac{W + W_T}{g} x'' + kx \quad \ldots\ldots [2]$$

where

$$F = F_B + C\frac{F_B}{g} x'' \quad \ldots\ldots [3]$$

The $C(F_B/g)x''$ force is the effective inertia force of the mercury. The value of inertia coefficient C for the case of a sphere in a confined volume is approximately 1. The force kx is the change in the bouyant force with x and in this case is negligible.

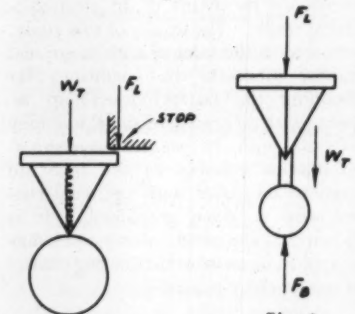


Fig. 2

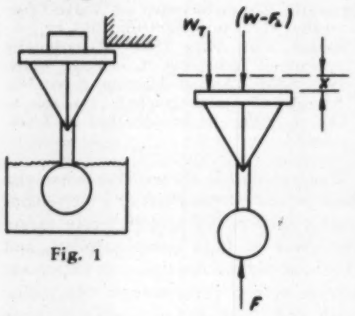


Fig. 4

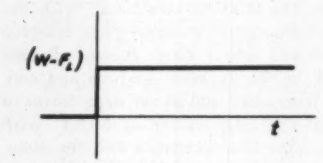


Fig. 3

Combining Equations [1], [2], and [3]

$$(W - F_L) = \frac{W + W_T + F_B}{g} x'' \quad \ldots\ldots [4]$$

Because the spring and damping forces during a short interval of time following release are small, the float undergoes a displacement at substantially constant

[3] Professor of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge, Mass. Mem. ASME.

[4] "High-Speed Weighing," by N. G. Maloney, MECHANICAL ENGINEERING, vol. 75, December, 1953, pp. 982–986.

acceleration whose value is given by

$$x'' = \frac{W - F_L}{W + W_T + F_B} g \quad \ldots\ldots [5]$$

The displacement of the float is

$$x = \tfrac{1}{2} x'' t^2$$

It will be noted that it is important to determine accurately the time interval over which x is measured. An error of 10 per cent in the measurement of t results in a 20 per cent difference in the displacement x.

The discussion of divergent and resonant systems appears irrelevant. The author's design is based on measuring a small initial displacement immediately following the application of a step change in force applied to a float. The use of locking techniques permits the use of a low-frequency, underdamped system with consequently high deflections and very high speeds.

It would be interesting to obtain information concerning the long-time reliability of such a system, as its success appears to depend much more critically upon the precision of the mechanism than the conventional weighing system.

Author's Closure

The author wishes to thank Dr. Hrones for his discussion of this paper. In answer to the last three paragraphs:

1 The measurement or control of time interval to a high degree of accuracy is dependent merely on the choice of well-established techniques.

2 The discussion of divergent versus resonant systems is of great importance since in it lies the basic concept of high-speed weighing as here presented.

3 As to the inherent life of the design of a high-speed weighing device versus a conventional weighing scale, it is obvious that the number of weighing operations rather than the time of useful service must be the basis of comparison. The mechanical design as presented was offered as a reduction to practice of a theoretical method. The development of the eventual detail of the mechanical design is still in the future.

N. G. Maloney.[5]

[5] Research Project Engineer, E. I. du Pont de Nemours & Company, Inc., Mechanical Development Laboratory, Wilmington, Del.

Reviews of Books

And Notes on Books Received in Engineering Societies Library

Railroad Engineering

RAILROAD ENGINEERING. Vol. 1. By William W. Hay. John Wiley and Sons, Inc., New York, N. Y., 1953. Cloth, 5½ × 9 in., references, fig., tables, index, ix and 483 pp., $7.50.

Reviewed by T. F. Perkinson[1]

ANY book should be reviewed with the purpose for which the book was written firmly in the mind of the reviewer. With this in mind, this reviewer readily concedes that the book under review is an excellent treatise that could find effective employment as a textbook for students who are primarily interested in railway work from the civil engineer's point of view.

Nevertheless, the reviewer's comments are, understandingly, colored by his own particular interests, and accordingly the following comments have to do largely but not exclusively with the various aspects of railway motive power as covered by the text.

The chapter on "Train Resistance" and the section on "Curve Resistance" are especially good as succinct condensations of the more important and voluminous data extant on these subjects.

A condensed treatment of the three most commonly-used "standard" forms of motive power (steam, diesel, and electric) is given, and the more important relative advantages and disadvantages that would affect the work of the railway civil engineer are nicely covered. However, and in view of the rapid ascendency of the diesel-electric locomotive with a concomitant decline in steam-power inventory on American railroads, one might well wonder whether or not the space allotted to discussion of details of steam-locomotive design could not have been advantageously reduced in favor of a more extended discussion of the diesel-electric and its characteristics.

In the brief treatment accorded the diesel engine (as the prime mover in a locomotive) the statement that "Successful development of a 2-cycle engine was necessary to bring the diesel into general use" as a locomotive prime mover, and the subsequent discussion of the 2-cycle engine, tend to give the uninformed reader the impression that the 2-cycle engine has pushed the 4-cycle diesel out of the railroad motive-power picture. As a matter of fact, there are many thousands of modern 4-cycle supercharged and nonsupercharged engines in operation on American railroads, and the supercharged 4-cycle engine is quite competitive with the 2-cycle form in the matter of power-weight ratios. The statement that the 2-cycle diesel gives "approximately twice the power of a 4-cycle engine for the same weight" is tenable only in theory. Thermal-loading limitations of piston-heads, cylinder-heads, and exhaust valves in the 2-cycle engine prevent practical realization of the theoretical power-weight ratio superiority. Turbosupercharging of the 4-cycle engine (there are no supercharged 2-cycle engines working on American railroads today) has brought about power-weight ratio equivalency between the two types as used in current railroad motive power.

In discussing horsepower ratings of the diesel-electric locomotive, the author would have done well had he called attention to the fact that the diesel-electric locomotive is nominally rated in terms of horsepower input to the generator for traction purposes, and that the rated brake horsepower output of the diesel engine, itself, is seldom available to

[1] Manager, Transportation Engineering Division, General Electric Company, Schenectady, N. Y. Mem. ASME.

other than the locomotive designer. Thus the nominal 2000-hp diesel-electric locomotive is in reality a 1700-hp unit so far as locomotive horsepower is concerned. On the contrary, the straight-electric locomotive is always nominally rated (in the U. S. A., at least) in terms of rail horsepower output, all of which is confusing to the uninitiated.

In the matter of electric-locomotive ratings, the data given by the author on traction motor permissible temperature rises for continuous and short-time operation are not representative of modern electric traction motor capabilities. Temperature rises of 120 C (on armatures) and 130 C on field windings with Class B insulation have been common practices for many years, while the more recently developed insulations employing glass and silicones tolerate temperature rises for short-time ratings to as high as 160 C.

The statement that "motors on a diesel locomotive, usually smaller and in a more confined space, overheat more quickly" than those on an electric locomotive is not factual. All modern traction motors are force-ventilated (blown with cooling air) and, in general, work to the same design temperature rises, since the same classes of insulation may be and most frequently are employed whether the motors be for straight electric or diesel-electric applications. As a matter of fact, the current tendency is toward the elimination of short-time ratings on diesel-electric applications altogether, with continuous ratings applying at maximum normal running adhesion values, which renders the motors more or less self-protecting against overheating.

In connection with the brief treatment of dynamometer cars and their uses in checking train performance, it would have been informative to call attention to the fact that where electric traction motor drive is employed on motive power, the ease and facility with which locomotive performance can be determined renders the dynamometer car somewhat obsolete. Electric instrument (voltmeters, ammeters, speedmeters) readings in conjunction with the manufacturers' motor characteristic curves are, in the main, more reliable, easier to use, and in many cases more economical than the general run of dynamometer car for checking train performance. These observations do not apply, of course, where the transmission in the motive power is other than electrical.

This book omits any treatment of yards and terminals, hump-classification facilities, passenger stations, bridges and trestles, Cooper's Loadings, tunnels, signaling, and traffic-control systems—all of which are of interest to the railway civil engineer in more or less degree, but this reviewer suspects that some of these omissions might be intended for inclusion in subsequent volumes on "Railway Engineering." The volume under discussion is entitled Volume 1, but nowhere in it is there any implication that it is volume one of a series. This reviewer hopes that it is the intention of Professor Hay to follow Volume 1 with subsequent volumes, and that, in particular, a lucid chapter on Cooper's Loadings will be included.

Library Services

ENGINEERING Societies Library books may be borrowed by mail by ASME Members for a small handling charge. The Library also prepares bibliographies, maintains search and photostat services, and can provide microfilm copies of any items in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th St., New York 18, N. Y.

Books Received in Library...

ASTM STANDARDS ON PETROLEUM PRODUCTS AND LUBRICANTS. American Society for Testing Materials, Philadelphia, Pa., 1953. 888 p., 9 × 6 in., paper. $6. This latest annual compilation contains 156 specifications, test methods, and definitions relating to petroleum and petroleum products, covering crude petroleum, motor and aviation fuels, lubricating oils, turbine oils, bituminous materials, and other broad classifications. Much of the material in the previous edition has been revised and there are 11 new methods included. A new section gives a summary of changes made in ASTM standards during 1953.

ASTM STANDARDS ON TEXTILE MATERIALS. American Society for Testing Materials, Philadelphia, Pa., 1953. 677 p., 9 × 6 in., paper. $5.25. Test methods, definitions, specifications, tolerances, and recommended practices for all textile materials—asbestos, bast and leaf fibers, cotton, glass textiles, rayon and acetate, silk, wool, and felt. The standards also cover fabrics, yarns, threads, and cordage; while test methods cover testing machines, humidity, and interlaboratory testing. There are also a number of tentative and proposed tests.

ANGEWANDTE GETRIEBELEHRE. By Kurt Hain. Hermann Schroedel Verlag, Hannover, Germany, 1952. 408 p., 9 1/4 × 6 1/2 in., bound. 24 DM. This book on applied kinematics is a treatise on the so-called periodic mechanisms—cam, crank, or link motions. The two parts cover, respectively, analysis and synthesis, giving (1) methods of investigating existing mechanisms, and (2) methods of designing mechanisms for specific conditions. There is a bibliography.

GROWTH OF INTEGRATED OIL COMPANIES. By John G. McLean and Robert Wm. Haigh. Harvard Business School, Division of Research, Soldiers Field, Boston, Mass., 1954. 728 p., 11 1/4 × 8 3/4 in., bound. $12. The emergence of large integrated oil companies as the predominant form of organization in the oil industry is the subject of this study. Part one depicts the structure of the industry in 1950; part two discusses the technological, economic, and business factors which resulted in integration; part three analyzes seven representative companies to determine differences in structure and in managerial policies; part four examines the position of the small refiners in the industry.

MATERIALS AND PROCESSES. By James F. Young. John Wiley & Sons, Inc., New York, N. Y., second edition, 1954. 1074 p., 9 1/4 × 6 in., bound. $8.50. This book aims to present, in a single volume, a broad study of the materials and manufacturing processes employed by engineering designers, and thus to provide information directly useful in the selection of materials. It is intended for classroom use and for engineers who wish an over-all picture. In addition to the general revision new chapters have been added on metallographic examination, statistical methods, and various nonmetallic materials.

1954 HEAT TRANSFER AND FLUID MECHANICS INSTITUTE. Held at University of Southern California, L.A. Stanford University Press, Stanford, Calif., 1953. 240 p., 11 × 8 1/2 in., paper. $5.50. These sixteen papers by specialists cover a wide range including heat and mass transfer under various conditions, heat transfer at hypersonic Mach number, shock-wave research, heat transfer from liquid metal, convection in electric fields, boiling characteristics, flow of water-air mixture, cavitation, and flame propagation research.

NYLON TECHNOLOGY. By Karl H. Inderfurth. McGraw-Hill Book Company, Inc., New York, N. Y., 1953. 335 p., 9 1/4 × 6 1/4 in., bound. $6.50. Emphasizing the methods used to process nylon, this book gives the history of nylon development, outlines modern manufacturing processes, and discusses the physical and chemical properties of nylon. Then follow detailed treatments of the methods of spinning staple, processing yarn by throwing, slashing, and quilling, and weaving and knitting of the yarn. There are also chapters on the dyeing, printing, and finishing of fabrics.

ASME BOILER CODE

Announcement

Pars. P-268 and A-65 to A-70, incl., and several drawings concerning those paragraphs, of the 1952 *Power Boilers*, have been completely revised. The length of this material prohibits its publication in MECHANICAL ENGINEERING, but it is available on request from the Secretary of the Boiler Code Committee and will be included in the regular 1954 Addenda to Power Boilers to be published in the fall.

ASME NEWS

With Notes on the Engineering Profession

Community Progress Through Engineering Sparks 1954 ASME Semi-Annual Meeting Program

Headquarters: William Penn Hotel, Pittsburgh, Pa., June 20–24. Wide-Scope Technical Sessions and Trips to Several Industrial Plants Program "Musts"

Tentative Program

ONLY preprints of *numbered* ASME papers will be available. Some of these papers may not be available in time to permit your receiving them in advance of the meeting. Your order will be mailed only when the complete order can be filled unless you request that all papers available ten days before the meeting be mailed at that time. Please order only by paper *number;* otherwise the order will be returned. The final listing of available technical papers will be found in the issue of MECHANICAL ENGINEERING containing an account of the meeting.

Available preprints of numbered papers may be purchased from ASME Order Dept., 29 West 39th St., New York 18, N. Y. Please order by number as listed in program.

The tentative program follows:

MONDAY, JUNE 21

8:00 a.m.

Registration

9:00 a.m.

Instruments and Regulators (I)

Experimental-Flight Methods for Evaluating Frequency-Response Characteristics of Aircraft, by *G. A. Smith* and *W. C. Triplett,* National Advisory Committee for Aeronautics (Paper No. 54—SA-3)

Frequency-Response Approach to the Design of a Mechanical Servo, by *H. A. Helm,* Bell Telephone Laboratories, Inc. (Paper No. 54—SA-36)

Differential-Analyzer Study of a Nonlinear Hydraulic Servomechanism,[2] by *J. T. Ahlin,* Douglas Aircraft Co., and *G. A. Bekey,* University of California (Paper No. 54—SA-4)[2]

9:00 a.m.

Power (I)

The Efficient Design of Piping Systems for Large Central-Station Steam-Turbine Applications[1]

Analysis of Pipe Systems With Special Expansion Features[1]

[1] See box on page 464.
[2] Presented by title only.

9:00 a.m.

Management (I)

Professional Self-Development of Engineering Administrators[1]

The Importance of Estimates in Guiding the Company's Future[1]

9:00 a.m.

Metals Engineering (I)

Rapid Heating of Large Steel Sections for Rolling

High-Speed Heating of Heavy Steel Sections[1]

Sixty-Cycle Induction Heating of Large Steel Sections[1]

Review of High-Speed Heating and Comparison With Heat-Transfer Obtained in Conventional Furnaces[1]

9:00 a.m.

Machine Design (I)

Manufacturing Methods of Power-Transmission Gears and Their Influence on Design Considerations, by *D. W. Bolstiber,* consulting engineer (Paper No. 54—SA-19)

Dynamic Loads on Spur and Helical Gear Teeth, by *J. B. Reswick,* Massachusetts Institute of Technology (Paper No. 54—SA-9)

Safe Stress Range for Deformation Due to Fatigue,[2] by *M. Kawamoto* and *K. Nishioka,* Kyoto University, Kyoto-Ski, Japan (Paper No. 54—SA-10)

12:15 p.m.

President's Luncheon

Presiding: *R. J. S. Pigott,* Past-President and Fellow ASME, consultant, Gulf Research & Development Co., Pittsburgh, Pa.

Speaker: *Lewis K. Sillcox,* President and Hon. Mem. ASME

Subject: **Paths We Pursue**

To be seen during the 1954 ASME Semi-Annual Meeting is the P-1-46-in. blooming mill, at Jones & Laughlin Steel Corporation's Pittsburgh Works. Shown is a bloom being worked at *center* and a finished slab passing out of the mill at *left.* An ingot waits at *right* to go into the mill.

Registration Schedule

Day	Time	Location
Sunday, June 20	3:00 p.m. to 5:00 p.m.	17th Floor
Monday, June 21	8:00 a.m. to 5:00 p.m.	17th Floor and Lower Level
Tuesday, June 22	8:00 a.m. to 5:00 p.m.	17th Floor and Lower Level
	7:00 p.m. to 8:30 p.m.	17th Floor only
Wednesday, June 23	8:00 a.m. to 5:00 p.m.	17th Floor
	8:00 a.m. to 12:00 noon	Lower Level
	6:30 p.m. to 7:15 p.m.	17th Floor
Thursday, June 24	8:00 a.m. to 3:00 p.m.	17th Floor and Lower Level

2:00 p.m.

Instruments and Regulators (II)

A Thermal Sine-Wave Apparatus for Testing Industrial Thermometers, by *Jonathan R. Keim* and *S. P. Higgins, Jr.*, Minneapolis-Honeywell Regulator Co. (Paper No. 54—SA-20)

A Thermal Sine-Wave Generator for Speed of Response Studies, by *Robert Looney*, Taylor Instrument Companies (Paper No. 54—SA-28)

The Dynamics of Filled Temperature-Measuring Systems, by *Otto Muller-Girard*, Taylor Instrument Companies (Paper No. 54—SA-29)

2:00 p.m.

Power (II)

Economic Comparison of River and Cooling-Tower Circulating-Water Systems, by *J. Lichtenstein*, Santa Fe Tank & Power Co., and *B. C. Sprague*, West Penn Electric Co. (Paper No. 54—SA-37)

Air-Preheater Size Selection to Improve Over-All Steam-Power-Plant Efficiency[1]

2:00 p.m.

Machine Design (II)—Lubrication Activity (I)

The Wear and Friction Properties of Materials Operated in High-Temperature Water, by *R. C. Westphal* and *J. Glatier*, Westinghouse Electric Corp. (Paper No. 54—SA-13)

The Role of Shock-Testing Machines in Design, by *C. E. Crede*, The Barry Corp. (Paper No. 54—SA-12)

2:00 p.m.

Management (II)

Plant Construction After a Major Disaster[1]

How the Norton Company Rebuilt Their Machine-Division Plant After a Tornado[1]

4:30 p.m.

Business Meeting

Presiding: *Lewis K. Sillcox*, President and Hon. Mem. ASME

Announcement of location of 1955 Semi-Annual Meeting

Election of Nominating Committee for 1955

Constitutional changes

TUESDAY, JUNE 22

8:00 a.m.

Registration

9:00 a.m.

Heat Transfer (I)

A Test Loop for Determining Heat-Transfer Coefficients by the Thermal Cyclic Method[1]

The Use of Numerical Analysis in the Transient Solution of a Two-Dimensional Heat-Transfer Problem With Natural and Forced Convection[1]

9:00 a.m.

Safety—Rubber & Plastics (I-A)—Production Engineering (I)

Panel on Engineering Safety, or How the Engineering Approach Is Solving Tough Safety Problems in Industry

Moderator: *Clyde C. Ruddick*, Pittsburgh Plate Glass Co.

Speaker: *John L. Young*, U. S. Steel Corp.

Team (*A*) *G. D. Cross*, Firestone Tire & Rubber Co., and *Earl Bishop*, Firestone Tire & Rubber Co.

Team (*B*) *H. B. Duffus*, Westinghouse Electric Corp., and *S. W. Sandberg*, Westinghouse Electric Corp.

9:00 a.m.

Machine Design (III)

On the Dynamics of Pressure-Controlled Hydraulic System, by *G. Reethof*, Massachusetts Institute of Technology. To be presented by *Fred Ezekiel*, M.I.T. (Paper No. 54—SA-7)

A Loading Fixture for Testing Circuit-Breaker Mechanisms, by *R. C. Van Sickle*, Westinghouse Electric Corp. (Paper No. 54—SA-18)

Some Applications of the Theory of Least Squares to Research and Development of Engineering Equipment,[2] by *J. A. Folse*, Washington, D. C. (Paper No. 54—SA-11)

9:00 a.m.

Rubber and Plastics (I)

Dielectric Fatigue Properties of Thermo-Setting Laminates[1]

Impact Thermo-Setting Plastics With Responsibilities[1]

Weather Aging of Styrene and Phenolic Plastics[1]

9:00 a.m.

Fuels (I)—Air Pollution—Power (III)

Important Considerations in the Use of the Wind Tunnel for Pollution Studies of Power Plants, by *G. H. Strom* and *J. Halitsky*, New York University (Paper No. 54—SA-41)

The Magnitude of Errors in Stack-Dust Sampling[1]

A New Method for Stack-Dust Sampling[1]

9:00 a.m.

Metals Engineering (II)

Characteristics of Heavy-Section Aluminum Alloy Products From Large Ingots[1]

Titanium Technology in Mid-1954[1]

Punching of Medium-Carbon Steel, by *S. K. Clark*, Case Institute of Technology (Paper No. 54—SA-35)

12:15 p.m.

Machine-Design Luncheon

Presiding: *C. Higbie Young*, Mem. ASME, professor in charge, machine-design department, Cooper Union School of Engineering

Presentation of Award to Prof. J. F. Blackburn

Speaker: *Crosby Field*, president, Plakice Corp ASME Medalist

Subject: **Creative Engineering**

2:00 p.m.

Metals Engineering (III)

Regulating Systems for Rolling-Mill Drives[1]

Controls of a Continuous-Annealing Line[1]

2:00 p.m.

Heat Transfer (II)

Temperature Charts for Internal-Heat Generation[1]

An Electrolytic Analog Applied to Heat Conduction Within a Transistor[1]

An Electrical-Geometrical Analog for Two-Dimensional Steady-State Heat Conduction With Uniform Internal-Heat Generation[1]

2:00 p.m.

Power (IV)

Comparative Performance of Turbine-Generator Units in Saturated-Steam Cycles[1]

The Mechanical Design of Liquid-Metal Cooled Nuclear Reactors[1]

2:00 p.m.

Gas Turbine Power (I)

The Combustion-Efficiency Problem of the Turbo-jet at High Altitude, by *I. W. T. Olsen, J. H. Childs*, and *E. R. Jonash*, NACA (Paper No. 54—SA-24)

A Study of Flame Stability Based on Reaction-Rate Theory, by *E. A. DeZubay*, Westinghouse Electric Corp. (Paper No. 54—SA-27)

2:00 p.m.

Lubrication Activity (II)—Applied Mechanics—Machine Design (IV)

Fretting Corrosion of Mild Steel in Air and in Nitrogen, by *I. Ming Feng* and *Herbert H. Uhlig*, Massachusetts Institute of Technology (Paper No. 54—SA-6)

Mechanism of Fretting Corrosion, by *Herbert H. Uhlig*, Massachussetts Institute of Technology (Paper No. 54—SA-5)

Prediction of Lubricating-Oil Viscosities at High Pressures, by *O. H. Clark*, Socony-Vacuum Oil Co., Inc. (Paper No. 54—SA-39)

2:00 p.m.

Rubber and Plastics (II)

Symposium on Rubber O-Rings

Designing With O-Ring Seals[1]

Compounding Principles Involved in the Production of O-Rings[1]

Molding Procedure for the Manufacture of O-Rings[1]

2:00 p.m.

Fuels (II)

Handling and Dustiness Characteristics of Fine Coal[1]

Trends in Production and Use of Natural Gas[1]

5:00 p.m.

Roy V. Wright Lecture

Presiding: *L. K. Sillcox*, President and Hon. Mem. ASME

Speaker: The Honorable *Raymond R. Tucker*, Mem. ASME, Mayor of St. Louis, St. Louis, Mo.

8:00 p.m.

Junior

How Do You Measure Engineering Success? by *H. N. Muller, Jr.*, Westinghouse Electric Corp.

[1] See box on this page.
[2] Presented by title only.

Preprint Orders

ONLY preprints of *numbered* ASME papers will be available. The final listing of available technical papers will be found in the issue of MECHANICAL ENGINEERING containing an account of the meeting. Preprints of ASME papers may be obtained by writing to the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Papers are priced at 25 cents each to members, 50 cents to nonmembers. Payment may be made by check, U. S. postage stamps, free coupons, or coupons which may be purchased from the Society. The coupons, in lots of ten, are $2 for members; $4 for nonmembers.

Preprints of unnumbered papers, listed in the tentative program, are not available because the review of these manuscripts had not been completed when the program went to press. The author's name and preprint number will appear with paper title in the final program (final program available only at meeting) as well as the issue of MECHANICAL ENGINEERING containing an account of the meeting, if the paper is recommended for preprinting.

Looking down new Westinghouse generator aisle: Longer than three football fields and seven stories high, this new generator-manufacturing aisle at the Westinghouse East Pittsburgh plant approximately doubles the firm's capacity to produce giant electric generators and large motors. Two levels of crane runways overhead accommodate three 50-ton cranes and two 200-ton cranes. The all-steel roof is 93 ft above the ground. On the floor is the latest equipment for assembly and test of giant generators. Westinghouse now has on order generators up to 260,000-kw capacity. Just three years ago such sizes were not even on the drawing board. The plant will be inspected during the 1954 ASME Semi-Annual Meeting, at William Penn Hotel, June 20–24.

WEDNESDAY, JUNE 23

8:00 a.m.

Registration

9:00 a.m.

Gas Turbine Power (II)

Application of High-Speed Strain-Gage Torquemeter to Turbomachinery Research, by *J. J. Rebeske, Jr.*, and *H. A. Buckner, Jr.*, NACA (Paper No. 54—SA-23)

An Automatic Control for Close Clearances in Rotating Machinery, by *A. Kantrowitz*, Cornell University (Paper No. 54—SA-25)

9:00 a.m.

Metal Processing (I)—Production Engineering (II)

The Grinding of Titanium Alloy[1]

Maintenance and Production Tooling in a Steel Plant, by *C. E. Youngblood*, Bethlehem Steel Co. (Paper No. 54—SA-38)

9:00 a.m.

Aviation—Lubrication Activity (III)—Gas Turbine Power (II-A)

The Closed-Circuit Lubrication System Applied to Turbojet-Aircraft Engine, by *R. G. Cunningham* and *P. H. Schweitzer*, Pennsylvania State University (Paper No. 54—SA-1)

Evolution of Turbojet-Engine Lubrication Systems[1]

Trends in Aviation Gas-Turbine Oil Systems[1]

[1] See box on page 464.

9:00 a.m.

Heat Transfer (III)

Heat Transfer From Spheres to a Rarefied Gas in Subsonic Flow[1]

Heat Transfer From a Rotating Plate[1]

A Note on Limiting Laminar Nusselt Number in Ducts With Constant-Temperature Gradient by Analogy With Thin-Plate Theory[1]

9,00 a.m.

Metals Engineering (IV)

Cost and Other Advantages of Powdered-Metal Parts[1]

Process and Application of Powder Metallurgy[1]

A New Concept of Pressing Parts From Powdered Metal[1]

12:15 p.m.

Inspection Trips

Among the various inspection trips scheduled for the Semi-Annual Meeting are the following: Gulf Research Laboratories, Harmarville, Pa.; Westinghouse Electric Corporation, East Pittsburgh Works; Fisher Body Division, General Motors Corporation, McKeesport, Pa.; Union Switch and Signal Division of Westinghouse Air Brake Company, Swissvale, Pa.; Duquesne Light Company, Elrama Station, Elrama, Pa.; Rockwell Manufacturing Company, Pittsburgh, Pa.; and Jones & Laughlin Steel Corporation, Pittsburgh, Pa.

Informal trips for small groups can be arranged at the following plants: United States Bureau of Mines, Mine Safety Appliance Company, Hagan Corporation, and Alcoa Building all in Pittsburgh, Pa.

6:30 p.m.

Reception

7:00 p.m.

Banquet

Presiding: *Henry Nicholas Muller, Jr.*, Mem. ASME, assistant to vice-president, engineering, Westinghouse Electric Corp., Gateway Center, Pittsburgh, Pa.

Speaker: *A. B. Van Bushirk*, vice-president, T. Mellon & Sons, Pittsburgh, Pa., chairman, The Allegheny Conference on Community Development

Subject: **Community Progress—A Challenge to the Engineer**

THURSDAY, JUNE 24

8:00 a.m.

Registration

9:00 a.m.

Power (V)—Metals Engineering (V)

Working-Stress Criteria for Nuclear-Power Plants[1]

The Thermal Design of Nuclear-Power Reactors[1]

Structural Problems for a Sodium-Cooled Reactor for Submarine Propulsion[1]

ASME National Nominations

THE 1954 Nominating Committee is to meet for two days, June 21-22, 1954, at the William Penn Hotel in Pittsburgh, Pa., where the Semi-Annual Meeting will be held. Open hearings will be held so that members may speak in behalf of their candidates for the office of President, Regional Vice-President, and Directors at Large any time between the hours of 10:30 a.m. to 12 noon; and from 2 p.m. to 5 p.m. on Monday, June 21, and on Tuesday, June 22, from 9:30 a.m. to 12 noon and, if necessary, from 2 p.m. to 5 p.m. Following the close of business of the 1954 Nominating Committee Meeting there will be held an Organization Meeting of the 1955 Committee presided over by R. S. Stover, chairman of the 1954 Committee. This meeting will take place on Tuesday afternoon or evening, June 22, following the Business Meeting of the 1954 Committee or, if necessary to extend the Business Meeting through Tuesday evening, the Organization Meeting will be held on Wednesday morning, June 23.

9:00 a.m.

Materials Handling (I)

Bulk-Materials Stock Piling, by *E. H. D. Gibbs*, Neyl & Patterson, Inc. (Paper No. 54—SA-30)

Methods and Costs in Coal Storage With Scrapers and Bulldozers, by *D. K. Heiple*, Le Tourneau-Westinghouse Co. (Paper No. 54—SA-32)

Flow of Solids in Bulk-Handling Systems, by *A. W. Jenike*, consulting engineer (Paper No. 54—SA-34)

9:00 a.m.

Production Engineering (III)—Metal Processing (II)

Interaction of Friction and Temperature at the Chip-Tool Interface in Metal Machining, by *F. F. Ling* and *Edward Saibel*, Carnegie Institute of Technology (Paper No. 54—SA-2)

A Periodic Re-Evaluation of Manufacturing Processes, by *Walter H. Friedlander*, Metcut Research Associates (Paper No. 54—SA-14)

9:00 a.m.

Gas Turbine Power (III)

Problems in Formulation of Design Procedures for Continuous-Flow Combustion of Hydrocarbons, by *G. S. Bahn* and *G. W. Kofler*, Marquardt Aircraft Co. (Paper No. 54—SA-22)

Exhaust-Gas Sampling of a Small-Scale Combustor and Determination of Combustion Efficiency[1]

Measurement of Total Emissivities of Gas-Turbine Combustor Materials, by *S. M. DeCorso* and *R. L. Coit*, Westinghouse Electric Corp. (Paper No. 54—SA-26)

9:00 a.m.

Heat Transfer (IV)

Thermal Properties, Boundary Layer

The Determination of Thermal Diffusivity of Aluminum Alloys at Various Temperatures[1]

The Thermal Conductivity of Organic Liquids[1]

An Investigation of the Effect of a Step in the Surface Temperature on the Heat Transfer to a Laminar-Boundary Layer[1]

9:00 a.m.

Process Industries

A Graphical Representation of the Frictional Losses in Commercial Pipe of Air and Steam Flowing Turbulently at Low Pressures, by *W. C. Knapp* and *Jesse W. Metzger*, C. H. Wheeler Manufacturing Co. (Paper No. 54—SA-17)

Fanning-Friction Factors for Air Flow at Low Absolute Pressures in Cylindrical Pipes, by *W. J. Bohnet*, Metals Research Laboratories, and *L. S. Stinson*, Elliott Co. (Paper No. 54—SA-16)

[1] See box on page 464.

9:00 a.m.

American Rocket Society (I)

Materials for Use in Rocket and Jet Propulsion

Tubing for Rockets, by *G. B. Brown*, Tube Reducing Corp. (Paper No. ARS—131-54)

Germets—New High-Temperature Materials, by *Robert Steinetz*, American Electro-Metal Corp. (Paper No. ARS—133-54)

Jet-Engine Alloys, by *G. A. Fritzlen*, Haynes Stellite Co. (Paper No. ARS—134-54)

Fabrication of Titanium Components, by *Arnold Rose*, I-T-E Circuit Breaker Co. (Paper No. ARS—135-54)

2:00 p.m.

Gas Turbine Power (IV)

Operating Experiences With Gas-Turbine Plants in the Steel Industry; Comparison of the Gas Turbine With Other Prime Movers, by *H. Pfenninger*, Brown Boveri Co. (Paper No. 54—SA-21)

A Gas-Turbine Process Using Added Steam[1]

Installation and Operating Experience With a Naval Gas-Turbine-Powered Landing Craft[1]

2:00 p.m.

American Rocket Society (II)

Materials for Use in Rocket and Jet Propulsion

Thermal Properties and Applications of High-Temperature Insulation, by *Paul Greebler*, Johns Manville Research Center (Paper No. ARS—129-54)

Propellants and Special Fluids Versus Valve-Seal Design, by *E. L. Hart*, Marotta Valve Co. (Paper No. ARS—130-54)

The Role of Plastics in the Liquid-Propellant Rocket Field, by *P. M. Terlissi*, U. S. Naval Air Rocket Test Station (Paper No. ARS—132-54)

Specialized Gaskets for Rocket Applications, by *J. B. Lasarus*, Gasket Packing & Specialty Co. (Paper No. ARS—136-54)

2:00 p.m.

Heat Transfer (V)

A Systematic and Rapid Procedure of Computing Approximate Characteristic Values Pertaining to Bare-Tube Crossflow Heat Exchangers, by *F. J. Neugebauer*, General Electric Co. (Paper No. 54—SA-40)

Heat-Exchanger Selection by Computation-Machine Methods[1]

Thermal Lags in Flowing Incompressible Fluid Systems Containing Heat Capacitors[1]

2:00 p.m.

Production Engineering (IV)—Metal Processing (III)

Production-Engineering Curricula, Content, and Intent, by *Orlan W. Boston*, University of Michigan (Paper No. 54—SA-8)

Production Engineering—An Engineering Education, by *Irvin L. Reis* and *K. J. Trigger*, University of Illinois (Paper No. 54—SA-15)

Official Notice ASME Business Meeting

THE Semi-Annual Business Meeting of the Members of The American Society of Mechanical Engineers will be held on Monday, June 21, 1954, at 4:30 p.m., Hotel William Penn, Pittsburgh, Pa., as part of the Semi-Annual Meeting of the Society.

The program is planned to include the announcements of the location of the 1955 Semi-Annual Meeting and election of the Nominating Committee for 1955.

This Business Meeting of the Members provides an opportunity for a free discussion of Society policies and procedures and all members are urged to attend.

2:00 p.m.

Materials Handling (II)

Use of Heavy Trucks in Industry, by *F. W. Lamb*, Automatic Transportation Co. (Paper No. 54—SA-31)

Shall It Be a Crane, a Conveyer, or an Industrial Truck? by *A. T. Gaudreau*, Gaudreau, Rimbach & Associates (Paper No. 54—SA-33)

WOMEN'S PROGRAM

SUNDAY, JUNE 20

3:00 p.m.	Registration
5:00 p.m.	Social hour
8:00 p.m.	Motion Picture: "Pittsburgh Redevelopment Program"

MONDAY, JUNE 21

8:00 p.m.	Registration and coffee
12:15 p.m.	President's Luncheon
2:30 p.m.	Riverboat trip—Monongahela and Ohio Rivers
8:00 p.m.	Motion Picture: "Pittsburgh Redevelopment Program"
8:30 p.m.	Informal bridge

TUESDAY, JUNE 22

8:00 a.m.	Registration
11:00 a.m.	Luncheon and entertainment at Pittsburgh Field Club
8:30 p.m.	Round trip to "The Greater Pittsburgh Airport"
8:30 p.m.	Informal bridge

WEDNESDAY, JUNE 23

9:00 a.m.	Registration
10:30 a.m.	Sightseeing tour of City of Pittsburgh
2:00 p.m.	Luncheon—*J. Calvin Brown*, speaker
6:30 p.m.	President's Reception
7:00 p.m.	Banquet

THURSDAY, JUNE 24

8:00 a.m.	Registration
9:00 a.m.	Tour of H. J. Heinz Plant and luncheon

ASME Calendar of Coming Events

June 14–17
ASME Oil and Gas Power Conference, Hotel Muehlebach, Kansas City, Mo.
(Final date for submitting papers was Feb. 1, 1954)

June 20–24
ASME Semi-Annual Meeting, William Penn Hotel, Pittsburgh, Pa.
(Final date for submitting papers was Feb. 1, 1954)

June 21–23
ASME West Coast Applied Mechanics Conference, University of California, Berkeley, Calif.
(Final date for submitting papers was Feb. 1, 1954)

Sept. 8–10
ASME Fall Meeting, Hotel Schroeder, Milwaukee, Wis.
(Final date for submitting papers was May 1, 1954)

Sept. 13–24
ASME Instruments and Regulators Division and Instrument Society of America Exhibit and Joint Conference, Commercial Museum and Convention Hall, Philadelphia, Pa.
(Final date for submitting papers was May 1, 1954)

Sept. 26–29
ASME Petroleum-Mechanical Engineering Conference, Statler Hotel, Los Angeles, Calif.
(Final date for submitting papers was May 1, 1954)

Oct. 28–29
ASME-AIME Joint Fuels Conference, William Penn Hotel, Pittsburgh, Pa.
(Final date for submitting papers—June 1, 1954)

Nov. 28–Dec. 3
ASME Annual Meeting, Statler Hotel, New York, N. Y.
(Final date for submitting papers—July 1, 1954)
(For Meetings of Other Societies, see page 473)

Meeting Inaugurated: *Left to right*, Eugene O'Brien, Gerardo Cruikshank, representing the Secretary of Hydraulic Resources; Jose M. Cabrera, L. K. Sillcox, President ASME; George D. Camp, Gustavo Ortiz Hernan, director of the Mexican Tourist Bureau; and J. Calvin Brown.

Inaugural Banquet: Among those attending the inaugural banquet of The American Society of Mechanical Engineers at the Hotel del Prado were, *left to right*, Jose Gomez Ojeda, Robert Hamilton Bacon, Gerardo Cruikshank, ASME President L. K. Sillcox, George Dashiell Camp.

ASME International Meeting in Mexico Wins Friends, Encourages Engineers

Better Understanding of, and Respect for, Engineering Accomplishments on Both Sides of the Border Was Keynote of This Meeting

THE 1954 ASME International Meeting of The American Society of Mechanical Engineers, which accomplished so much toward furthering better understanding and friendship between the engineers of Mexico and the United States, was opened in Mexico City, March 10, with an impressive inaugural ceremony in the auditorium of the Federal Electricity Commission.

Most of the 300 members of the Society attended this first meeting, highlighted by welcoming speeches by high officials of the Mexican Government. ASME President L. K. Sillcox called the meeting to order and in a brief speech thanked the Mexican officials, the members of the Society, and all who contributed to the success of the Meeting.

G. Ortiz Hernan, head of the Mexican Tourist Bureau, welcomed the members to Mexico and expressed his wishes for a "pleasant and profitable stay." Gerardo Cruikshank, personal representative of the Department of Hydraulic Resources, also welcomed the delegates and assured them that "meetings such as these give an opportunity for the exchange of experiences between Mexican technicians and those of other countries, thereby achieving desirable and fruitful ties beneficial for the world's technical knowledge."

The President's Luncheon

The President's Luncheon was held at the Hotel del Prado, headquarters for the three-day meeting. On this occasion Mr. Sillcox made a significant speech on the meaning of Mexico, in which he said, "The polite, artistic, mature civilization of Mexico, and the strenuous self-reliant temper of the United States correct and supplement each other.

"Mexico and the United States have developed side by side. The major thread in their respective national histories has been their mutual influences over a long period.

"Relations between both countries have seldom been better than at the present time. The general atmosphere of harmony in the diplomatic realm is more than a superficial accord pressed in response to troubled world situations. It has solid roots both in peoples and in Governments."

He added, "In Mexico we have found a proud productive country. Nothing could symbolize more fully or hold a greater potential wealth of mutual confidence and co-operation than your possession of an institution of this sort . . . [new University Center being constructed in Mexico] for we can meet on equal terms and serve each other constructively and in the highest sense."

Inspection Trips Define Technical Sessions

A visit to the leading industrial installations of Mexico City illustrated the day's discussions. The early trip included Cia. Hulera Goodyear Oxo, S.A., Guanos y Fertilizantes, S.A., Distribuidora Mexicana, S.A.—D.M. Nacional, and La Consolidada, S.A. Unanimously the visitors expressed their surprise at the progress achieved by Mexico during the past few years and particularly admired the growth of the city and the high production level of articles manufactured in these plants.

Differences Noted

James P. Tattersfield, J. H. Fedeler, Carl F. Kayan, and James Woodburn spoke on interesting phases of the Mexican mechanical industry and existing differences between the Mexican and the American systems of production. Ings. Jose M. Cabrera, official of the Federal Commission for the Reorganization of the Sugar Industry, Xavier Fuentes, and Salvador Almanza gave a detailed description of the San Bartolo vertical impulse turbine.

In the afternoon another instructive inspection trip highlighted the talks. The members were taken to the enormous diesel-electric plant at Tacubaya, where Max O. Bunge, director of the plant, and J. K. Jennings, assistant technical director of the Mexican Light and Power Company, showed the visitors the main features and equipment of the Tacubaya plant. Special interest was expressed because of the large size of its units (the largest in the world when it was put into operation), and because of its operation with Mexican bunker-C fuel oil.

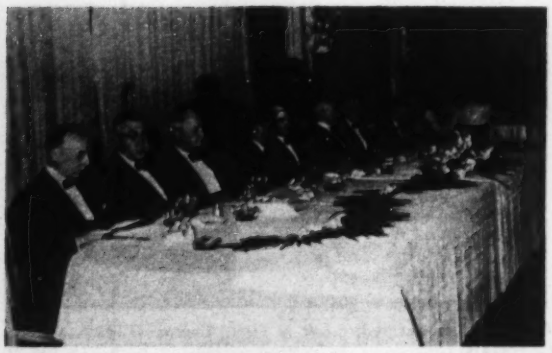
The Tolteca cement factory was next on the conducted tour, with Luis Elek, general manager, acting as host. The day's activities closed with a banquet at the Chandelier Room of the del Prado Hotel, when a special message from Ing. Luis Giannastassio, president of UPADI, was read.

The three-day meeting closed with a banquet meeting at the Casino Espanol, featuring speeches by ASME officials expressing their gratitude for the warm reception the Mexican authorities extended and to the Mexican members of the Society for the successful implementation of the convention.

The morning activities were chiefly devoted to visits and inspection trips to leading Mexico City industrial and technical installations. Visitors were impressed with the operations to be seen at Industria Electrica de Mexico; Reynolds International de Mexico, S.A.; General Motors de Mexico, S.A.; Cerveceria Modelo, S.A., one of ten well-known breweries (samples unlimited) in the Republic of Mexico; Colgate y Palmolive Peet, S.A., and the Petroleos Mexicanos (Pemex) Atzcapotzalco Refinery. This is one of the six petroleum refineries in the Republic of Mexico. It was constructed in 1946.

The farewell banquet was held at the Casino Espanol at noon with most of the delegates and wives attending. Shortly after the banquet different parties left for Taxco, Cuernavaco, and Acapulco. Many of the visitors availed themselves of the opportunity to see Mexico either on one of the many fine individual tours arranged by the Mexico Section or

Honored Guest: Francisco T. Mancilla represented Communications Secretary Carlos Lazo as guest of honor at the Thursday evening ASME Banquet in the Hotel del Prado. Shown with Mr. Mancilla, *left*, is J. K. Jennings, general chairman of the meeting.



Banquet: ASME delegates shown at Thursday evening banquet at the Hotel del Prado are, *left to right:* J. Calvin Brown, Eugene O'Brien, James M. Todd, Francisco T. Mancilla, J. K. Jennings, ASME President L. K. Sillcox, G. D. Camp, C. H. Shumaker, and C. E. Davies.

Inspection trip to one of Mexico's giant industries

At the Fiesta Mexicana, held at Rancho del Artista

the tour which was arranged by Ernest Hartford, deputy secretary of ASME. However the trip was made, Mr. Sillcox seems to have said it so well for all who attended when he remarked: "Our stay in Mexico has been as pleasant as it has been profitable. The exchange of opinions between our fellow members in Mexico and the North American visitors has been of great value to us and it is to be hoped that another ASME meeting will soon be held in this wonderful country.

"The progress made by the Mexican people and the industrial growth during the past few years has been indeed impressive.

"In the name of my fellow delegates, I wish to thank the Mexican authorities and the Mexican people for their co-operation."

Committees

The committees in charge of arrangements for the International Meeting included the following: *General Committee*, J. K. Jennings, *chairman; Technical Events*, David B. Goldstein, *chairman; Reception and Information*, G. C. Siefert, *chairman*, R. S. Ellis; *Hotel Arrangements*, F. Aubert, *chairman*, E. Chicurel U., Glenn N. Davis, and David B. Goldstein; *Entertainment*, T. W. Poole, *chairman*, E. F. Sear, and R. S. Ellis; *Papers*, David B. Goldstein, *chairman; Transportation*, J. Luque L., *chairman*, R. Lamontagne; *Office and Translation—Registration Clerks*, A. Reiter, *chairman*, E. Chicurel U.; *Press*, R. Lamontagne, *chairman; Government Relations*, L. Lozanne, *chairman*, R. Lomantagne and J. Luque L.; and *Treasurer*, Glenn N. Davis.

Availability List for 1954 International Meeting Papers

THE papers in this list are available in separate copy form until Jan. 1, 1955. Please order only by paper *number;* otherwise the order will be returned. Copies of these papers may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y.

Paper No.	*Title and Author*
54—Mex-1	Mechanism of Cavitation Inception and the Related Scale-Effects Problem, by R. W. KERMEEN, J. T. McGRAW, and B. R. PARKIN
54—Mex-2	Conveying Equipment in Cane-Sugar Mills, by C. CONRAD RINELLI
54—Mex-3	Factors Affecting Oil-Drain Practices for Diesel Engines, by L. F. MOODY, JR., and J. C. GIBB
54—Mex-4	Bagasse Burning in the Mexican Sugar Industry, by ORTO DE LORENZI
54—Mex-5	The Spreader Stoker in the Sugar Factory, by EARLE C. MILLER
54—Mex-6	Bagasse as a fuel for Steam Generation, by F. D. WILSON
54—Mex-7	Electric Power Production in the United States, by C. W. E. CLARKE and W. P. GAVIT
54—Mex-8	Successful Application of Standardized Diesel-Electric Motive Power to the World's Railways, by MANUAL ALONSO
54—Mex-9	The San Bartolo Vertical-Impulse Turbine, by JAVIER FUENTES, SALVADOR ALMANZA, and W. J. RHEINGANS
54—Mex-10	Diesel Plant Design—Influence of Fuels and Higher Engine Ratings, ROBERT CRAMER, JR.
54—Mex-11	Refrigerating-Plant Performance Characteristics by Electrical Analog Analysis, by CARL F. KAYAN
54—Mex-12	Power and Recovery House, by E. DAVALOS and A. DE LA MACORRA

54—Mex-13 Frasch Sulphur Mining, by James Woodburn

54—Mex-14 Grinding Capacities of Cane-Sugar Mills, by Jose M. Cabrera

54—Mex-15 Engineering of Vacuum-Filter Station in Cane-Sugar Factories, by Lloyd Jacobsen

54—Mex-16 A New Approach to Metal-Forming Problems—Experimental Stress Analysis for a Tubular Extrusion, by E. G. Thomsen

54—Mex-17 Recent Mechanical-Engineering Developments in Petroleum Production, by Emory N. Kemler

54—Mex-18 A Recent Development in the Measurement of the Sugar-Supersaturation Coefficient, by R. L. Miller

54—Mex-19 A Contribution to the Knowledge of Pressure Measurements During Metal Deformation, by J. Frisch

54—Mex-20 The Maintenance and Operation of the Tacubaya Diesel Plant, Mexico City, by J. K. Jennings

54—Mex-21 Modern Pipe Lining—Today and Tomorrow, by A. H. Newberg and E. C. Schuster

54—Mex-22 Recent Mechanical-Engineering Developments in Petroleum Refining, by J. S. Rearick

Third American Power Conference Held in Chicago, Ill.

At the third American Power Conference held at the Sherman Hotel in Chicago, Ill., on March 24–26, one of the high lights was participation in Light's Diamond Jubilee Celebration marking the seventy-fifth anniversary of the invention of the electric light by Thomas A. Edison. With a registration approaching 2500, attendance at technical sessions and special events reached record heights.

Light's Diamond Jubilee Celebration

Opening the meeting, Lenox R. Lohr of the Chicago Museum of Science and Industry, paid tribute to the pioneer work of Thomas A. Edison. He noted that the invention of the electric light came just 75 years after Watt's steam engine was put into practical use in this country. Vice-Admiral Harold G. Bowen, Hon. Mem. ASME, of the Thomas Alva Edison Foundation, Inc., continued in a historical vein in a paper entitled "The Beginnings of the Light and Power Industry." This included a brief account of experimental work at the Edison laboratories in Menlo Park, N. J., and the early problems of manufacturing.

In his address at Light's Diamond Jubilee Dinner, C. H. Moses, president of Arkansas Power and Light Company, commented optimistically on prospects for the next 25 years. He anticipated a doubling of national income within that period and an increase in the working populace from 62 to 85 million. On the other hand, Mr. Moses raised questions concerning the future role of Government in business, noting that some rights surrendered during World War II have never been restored to individuals. He declared that business has never faced a greater challenge, nor has it had greater opportunities and responsibilities than at the present. By way of example he told of the activities of his own company in promoting citizenship responsibility in its State.

Research and the Electric-Power Industry

William A. Lewis of the graduate school at Illinois Institute of Technology, and Jesse E. Hobson of Stanford Research Institute, brought attention to the fact that the future of the electric power industry is threatened because it is neglecting the basic research needed to keep any industry in a competitive position. In a paper entitled "Research and the Electric Power Industry" they showed that there has been too much dependence upon the research efforts of a few electrical manufacturers. Comparatively little is known concerning the amount of research now being conducted by the utilities, and one of the first steps would be to have a team of research specialists make personal visits to selected companies to obtain information which would serve as a basis for the intelligent evaluation of the industry's present status. The authors proposed that an industry-wide association with affiliated laboratories be formed with an annual budget of $7 million.

The Power Industry—A Challenge to Engineers

At the opening luncheon of the American Power Conference, sponsored by The American Society of Mechanical Engineers, Walter H. Sammis, president of Ohio Edison Company and Edison Electric Institute, stated that the electric light and power industry is basically an engineering operation and because of its technical nature always will be. Its financing, sales activities, public relations, accounting, and the legal phases of the business are all built upon engineering characteristics. Growth of the industry has been linked with engineering accomplishments and depends upon top-quality leadership.

Federal Power Commission

At the AIEE luncheon of the conference J. K. Kuykendall, chairman of the Federal Power Commission, told that only 21 per cent of the nation's potential hydroelectric-power capacity has been developed. Half of this has been accomplished through privately financed projects and the remainder through public projects. Present policy is for the Federal Government to undertake construction of only those water-resource-development projects or parts of projects which cannot be built by local interests or which have a national significance. Other projects are to be left to nonfederal public or private interests.

The Honorable Douglas McKay, Secretary of the Interior, Washington, D. C., speaking at the All Engineers Dinner, disclosed that an agreement has just about been reached between the Federal Power Commission, the Department of the Army, and the Department of the Interior with respect to a uniform and equitable method of cost allocation for Department projects. He added that power must bear its full share of costs, and these must be returned to the Federal Treasury, with interest, within a 50-year period.

Future Energy Sources

In his address A. C. Monteith, Hon. Mem. ASME, vice-president in charge of engineering, Westinghouse Electric Corporation, discussed the future of energy sources. If the present rate of increased use of energy is continued, he declared, some new source will have to be found, and with the trend current developments indicate that source is evidently going to be the atom. He predicted that atomic-powered generation will find an orderly application on utility systems and that present equipment will not become obsolete except as it becomes economically advisable to retire it.

The American Power Conference, organized in 1952 as successor to the Midwest Power Conference, is sponsored by the Illinois Institute of Technology in co-operation with 12 university and ten local and national engineering societies.

ASME West Coast Applied Mechanics Division Conference at Berkeley

West Coast Applied Mechanics Division Conference of The American Society of Mechanical Engineers will be held at the University of California, Berkeley campus, June 21–23. Co-operating with the Conference this year will be the Applied Mechanics Division of the American Society of Civil Engineers, who will sponsor one session on structures. Approximately 18 papers will be presented under the following sessions: Elasticity and shells, structures, properties of materials, nonlinear dynamics, and dynamics.

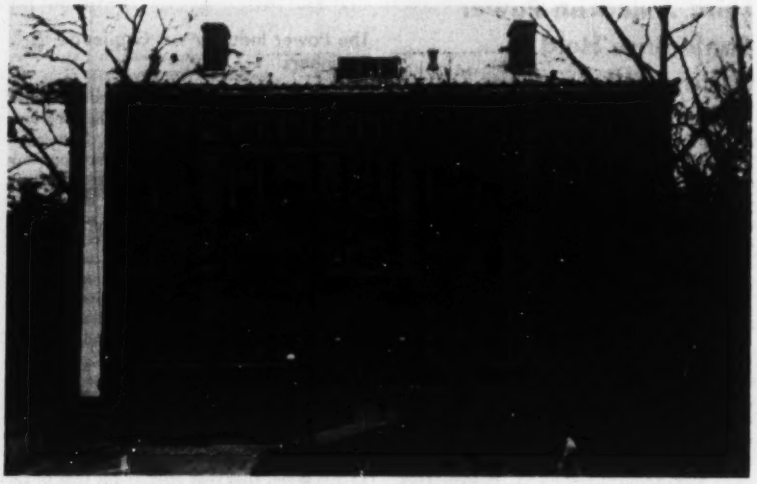
Scheduled for the evening of June 21 will be a social program with dinner at the University of California Faculty Club. Tours of the campus will be arranged and information regarding points of interest will be made available.

All ASME and ASCE members interested in the field of applied mechanics, as well as other engineers, are invited to attend the Conference. Information regarding accomodations can be obtained by writing to Prof. Walter Soroka, Committee on Arrangements, Department of Engineering, University of California, Berkeley 4, Calif.

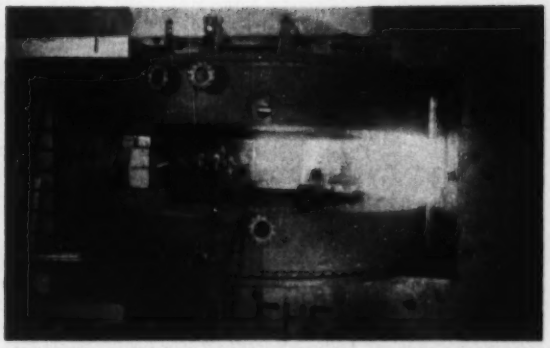
For information regarding the technical program write to Prof. William T. Thomson, Secretary, West Coast Committee, Department of Engineering, University of California, Los Angeles 24, Calif.

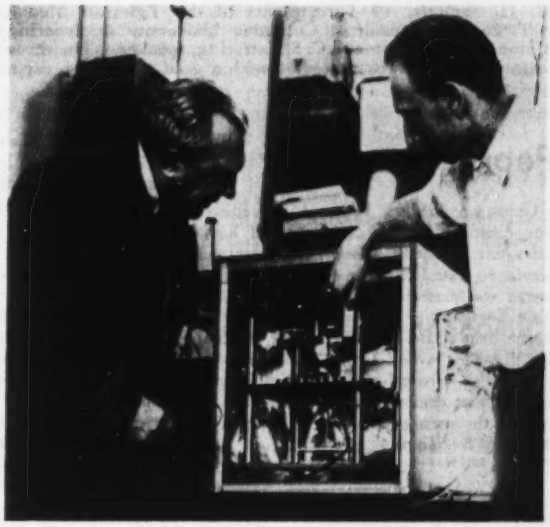
Columbia University Today. New York State's oldest institution of learning, Columbia, was started in the vestry room of the new school house adjoining Trinity Church, on lower Broadway, in 1754. Columbia, celebrating in 1954 its Bicentennial Anniversary, is still on Broadway—this time from 114th St. to 122nd St. Located on Morningside Heights, Columbia has occupied this, its fourth home in two centuries, since 1897. The first was at Trinity Church, 1754–1760; the second at Park Place, 1760–1857; and the third at Madison Ave. and 49th St., 1857–1897. Since its establishment Columbia produced many of our country's early leaders. When it was opened as King's College in 1754, Columbia had eight students and one faculty member, President Samuel Johnson. The University now has an annual enrollment of about 25,000 students and a faculty of 3500; and confers more than 4000 degrees annually.

Columbia University's Bicentennial Dedicated to "Man's Right to Knowledge and the Free Use Thereof"

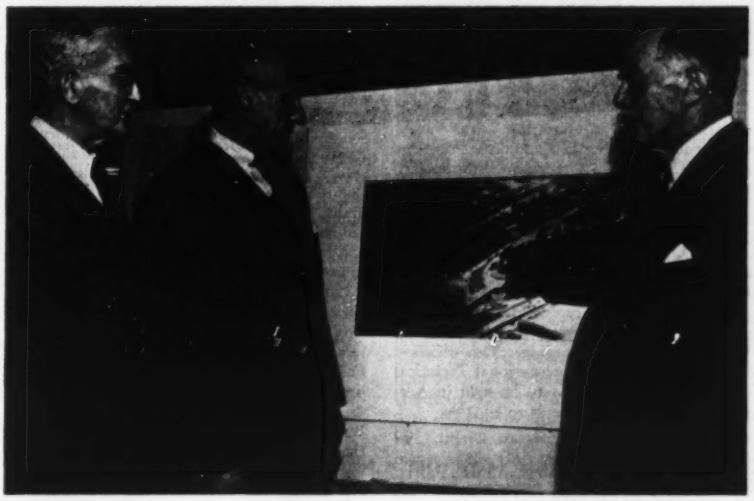


Columbia University School of Mines Building. In 1864, 33 years before Columbia occupied its present site, Thomas Egleston founded the first School of Mines in the country and thus started engineering education at Columbia. The University and its School of Engineering have sought one end result—broad training for "the complete man" and through him the betterment of humanity. Some Columbia Engineering alumni who have made significant contributions to the world include: Walter H. Aldridge, guiding genius of Texas Gulf Sulphur; Alfred C. Beatty, international mining engineer; Hamilton Castner, refiner of aluminum and inventor of the Castner-cell; William F. Gibbs, designer and engineer of America's newest superliner, "*United States*"; Irving Langmuir, Nobel Prize winner in chemistry; Robert A. Millikan, Nobel Prize winner in physics; Sir Stephen J. Pigott, engineer of the "*Queen Mary*" and "*Queen Elizabeth*"; Robert C. Stanley, late head of International Nickel. Columbia research also is clearly revealed in some of the contributions that have come out of its laboratories: Bakelite and Velox photographic paper, both invented by Prof. Leo Baekeland; the regenerative circuit, superheterodyne radio, and frequency modulation, the creations of Prof. E. H. Armstrong; the commercial methods of chromium plating, credited to Prof. Colin Fink; the loading coil, which established the practicability of long-distance telephone communication, invented by Prof. Michael Pupin; the hydrogen atom of atomic weight two, discovered by Prof. Harold C. Urey; the founding of the first atomic-energy project (the Manhattan District)—the scientific development under Dr. John R. Dunning (now dean of the School of Engineering) which was the foundation for the construction and operation of the gaseous-diffusion plant at Oak Ridge, separating U235; the establishment of a 400-million electron-volt cyclotron in collaboration with the Navy and the Atomic Energy Commission; and the development of electronic analog computation.





Mechanical Engineering at Columbia. Since 1897, when the School of Engineering inaugurated its department of mechanical engineering, Columbia has been providing superior training in this field. This department has established a curriculum which constantly has been adapted to changing conditions and knowledge and has always been closely related to the University and Columbia College. The department's senior teaching staff of seven has encouraged, if not directed, its students to extend their studies beyond the technologies and to take advantage of contact with the great students and philosophers of the University. The department has pioneered in providing "men-in-industry" courses—at hours when they may be taken by part-time graduate students holding regular jobs in their profession and in such subjects as gas-turbine engines, refrigeration, aerodynamic instability, heat transfer, and air conditioning. Outstanding specialists in these phases of mechanical engineering are brought from industry to lecture on the campus. *Upper left* photo shows one bay of the machine-tool laboratory; in *upper right* is shown the Nevis Cyclotron at Irvington, N. Y., under inspection, and *at right*, Prof. Carl F. Kayan is shown with a doctoral candidate examining special thermocouple switching system of a thermal-conductivity apparatus. Members and graduates of Columbia's Department of Mechanical Engineering have gained wide recognition in their profession: Charles E. Lucke, inspired teacher and practicing engineer; H. L. Parr, Stevens professor emeritus, skilled laboratory director; Theodore von Kármán, world authority on aerodynamics and now Honorary Professor of the Department; Theodore Baumeister, authority in steam-power station analysis; and Carl F. Kayan, specialist in heat transfer and thermodynamics applications. The laboratories of the department have produced invaluable developments in gas-engine design, surface combustion (flameless), electrical analysis, thin-film lubrication, temperature measurement, cold storage, and metal processing. Its faculty includes outstanding authorities on such matters as heat transfer, aerodynamics, fluid dynamics, and power generation.



Columbia Tomorrow. Throughout 1954 more than 400 institutions of higher learning here and abroad will join in an unprecedented intellectual fiesta to pay tribute to Columbia University. Dr. Grayson Kirk, president of the University, firmly believes that man has a right to knowledge. He believes that freedom of expression and research are inseparable from that right. Now Columbia looks ahead—with far-reaching plans for the Columbia University Engineering Center. Prof. G. B. Pegram, *left*, is shown discussing plans for the development of the new $22,150,000 center with Joseph W. Barker, *center*, and Dean James Kip Finch. The center offers a practical plan to meet the demand for more and better engineers. It specifically offers the men and the plan for advancing science and mechanical engineering. A contribution to the work of the Engineering Center in mechanical engineering promises the furtherance of security, prosperity, and human welfare. The Columbia University Engineering Center will be built around Columbia's present school of engineering.

Columbia Engineers Honored. *Left to right*, **F. A. Ayer and W. H. Sammis, 1954 recipients of the Egleston Medal; P. E. Landolt, president, Columbia University Engineering Alumni Association; and C. F. Kettering, speaker. The three honored guests were presented with a gold-coin watch each.**

ASME Represented at Egleston Dinner. *Left to right*, **L. K. Sillcox, ASME President; C. F. Kettering, Fellow ASME; and C. E. Davies, secretary of ASME. Mr. Kettering said that original thinking is periled by over-specialized technical study in his talk, "An Inventor Looks at Technical Education."**

People . . .

GEORGE A. STETSON, Fellow ASME, editor, The American Society of Mechanical Engineers, received the 1954 Award for Meritorious Service to Yale. On May 6 the certificate of award was presented to Mr. Stetson by the Yale Engineering Association at its annual dinner held at the Yale Club in New York, N. Y. This award is made to one who, through his outstanding contribution in service to the engineering profession, has increased the prestige and esteem of the Yale School of Engineering.

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The International Committee of Scientific Management has conferred upon LILLIAN MOLLER GILBRETH, Hon. Mem. ASME, the highest accolade which international management can offer. The Gold Medal of CIOS, awarded triennially in recognition of "fundamental contributions to the general body of management thinking," was presented to Dr. Gilbreth at the official banquet of the Tenth International Management Congress which was held from February 19 to 24 in Sao Paulo, Brazil. The presentation of the award marked the first time that a woman has been accorded this distinction by CIOS.

Another first for Dr. Gilbreth—she is the first woman to win the Washington Award since the honor was first conferred upon Herbert Hoover, Hon. Mem. ASME, in 1919. This award is presented to an engineer by fellow engineers for accomplishments which preeminently promote the happiness, comfort, and well-being of humanity by the Founder Societies and Western Society of Engineers. Dr. Gilbreth was presented with the award April 7, 1954, in Chicago, Ill., and on this occasion the Society was represented by L. K. SILLCOX, President ASME.

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DONALD MCGREGOR STEPHENS, chairman and general manager of The Manitoba Hydro-Electric Board, and president and general manager of the Winnipeg Electric Company of Winnipeg, Man., Can., will become president of The Engineering Institute of Canada at the annual general and professional meeting to be held at Quebec City, May 12–14.

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FRANK A. COWAN, assistant director of operations, long lines department, American Telephone & Telegraph Company, New York, N. Y., holder of 17 patents in the communications field, has been awarded the 1953 Lamme Gold Medal. The medal, one of engineering's high honors, will be presented at the opening session of the five-day summer and Pacific general meeting of the American Institute of Electrical Engineers at Los Angeles, Calif., June 21–25.

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FRANK A. AYER, international copper-mining consultant, and WALTER H. SAMMIS, president of Ohio Edison Company, were the 1954 recipients of the Egleston Medal, Columbia University's highest award "for distinguished engineering achievement." The awards, this year in honor of Columbia's Bicentennial Celebration and the engineering school's ninetieth anniversary, were made April 14 at dinner ceremonies in the grand ballroom of the Waldorf-Astoria Hotel, New York, N. Y. CHARLES F. KETTERING, Fellow ASME, director of General Motors Corporation, was guest speaker at the dinner. L. K. SILLCOX, President and Hon. Mem. ASME, represented the Society at this function.

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LEON G. LEPAIGE, Mem. ASME, director and head of engineering department, Sofina, Brussels, Belgium, has been designated Honorary Vice-President to represent the Society at the twenty-fifth anniversary celebration of De Vlaamse Ingenieursvereniging. This occasion will be marked by an International Technical and Economical Congress to be held in Antwerp, Belgium, from June 14 to 19, 1954.

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LEONARD J. FLETCHER, Mem. ASME, Peoria, Ill.; CARTHRAE M. LAPPOON, Mem. ASME, East Pittsburgh, Pa.; WEBSTER N. JONES, Pittsburgh, Pa.; STERLING P. REYNOLDS, Caruthersville, Mo.; REX M. WHITTON, Jefferson City, Mo.; were presented with Missouri Honor Awards for distinguished service to engineering at a special convocation at the University of Missouri on March 20, climaxing Engineers' Week. A similar award was made to E. I. du Pont de Nemours and Company of Wilmington, Del., and was accepted by GRANVILLE M. READ, Mem. ASME, who is chief engineer of the company.

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HARRY A. WINNE, Hon. Mem. ASME, atomic engineer, and former vice-president of the General Electric Company, was named as winner of the 1954 award of the National Society of Professional Engineers. Official presentation of the award will be made at the society's annual dinner in Milwaukee, Wis., June 12.

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ALFONSO TAMMARO, manager of the Chicago Operations office of the U. S. Atomic Energy Commission since 1947, was named assistant general manager for research and industrial development. AEC, which has been moving steadily toward giving private industry a greater role in working for peaceful use of nuclear energy, announced the appointment on April 7. The Commission's announcement stated his duties would include assisting in "co-ordinating and directing the AEC programs currently under the direction of the Divisions of Reactor Development, Biology and Medicine, and Research, and the Office of Industrial Development."

Other appointments include: EDWARD J. BLOCK to be director of the Production Division; JOHN A. DERRY to be director of the Division of Construction and Supply; JOHN J. FLAHERTY to take over Mr. Tammaro's former post in Chicago; FRANK K. PITTMAN to be deputy director of the Production Division; WILLIAM K. MAHER to be deputy director of the Division of Construction and Supply; GEORGE F. QUINN to be assistant director for Operations of the Production Division;

W. Kenneth Davis, Mem. ASME, to be assistant director (technical) of the Division of Reactor Development; and R. E. Hollingsworth, Assoc. Mem. ASME, to be assistant director of the Division of Production.

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Herbert K. Brown, Assoc. Mem. ASME, director of the Graduate Division of the college of engineering at Northeastern University, has been appointed dean of the Graduate Division, effective July 1.

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Grover Loening, pioneer aviation industrialist and inventor, has been appointed chairman of the Advisory Council of the Institute of Air Flight Structures at Columbia University. Others who will serve on the Council with Mr. Loening will be: Preston R. Bassett, president, Sperry Gyroscope Company; Hugh L. Dryden, Fellow ASME, NACA director; Lester D. Gardner, Affiliate ASME, founder of IAS; Harry F. Guggenheim, president, Daniel and Florence Guggenheim Foundation, which supports the Institute; Roy A. Hunt, chairman of the Executive Committee, Aluminum Company of America; Francis S. Murphy, chairman, Connecticut Aeronautics Commission; George B. Pegram, Fellow ASME, vice-president emeritus of Columbia University; Leon H. Swirbul, president, Grumman Aircraft Engineering Corporation; and G. Edward Pendray, Mem. ASME, senior partner, Pendray and Company.

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Henry R. Kessler, vice-president ASME, Region II, will represent the Society at the inauguration of Francis H. Horn as president of Pratt Institute on May 15.

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Edgar H. Dix, Jr., assistant director of research, Aluminum Company of America, received the Frank Newman Speller Award of the National Association of Corrosion Engineers at the annual banquet held during the association's tenth annual meeting, March 17, 1954.

University of Pennsylvania Reorganizes Engineering Schools

Women Students to Be Admitted to Every University Educational Division

The administration of teaching and research in engineering at the University of Pennsylvania has been completely reorganized in order to co-ordinate and extend the University's activities in these fields.

Under the reorganization, the Towne Scientific School has been divided into four separate Schools of chemical, civil, mechanical, and metallurgical engineering, each of which will have its own faculty.

Directors have been named to head the four newly-created schools and the Moore School of Electrical Engineering, while two assistant vice-presidents for engineering also have been appointed.

Institute for Co-Operative Research

In addition, provision has been made for the establishment of an Institute for Co-Operative Research to stimulate, co-ordinate, and manage investigative activities in the engineering field for industry, foundations, and government.

All of these various engineering units will function under Carl C. Chambers, vice-president in charge of engineering affairs.

No physical changes are necessitated by the reorganization, it was pointed out. The four new schools were formerly departments of the Towne School and will be housed in the Engineering Building, as heretofore. However, the building's name will be changed to the Towne Building.

Administrative Officers

All seven administrative officers, whose appointments were recently announced, hold full professorships in engineering at the University and will continue their teaching work in addition to serving as administrators.

The two assistant vice-presidents named are S. Reid Warren, Jr., who will be in charge of the program of engineering studies at the undergraduate level, and Arthur N. Hixson, who will have charge of graduate studies in engineering.

Dr. Warren is professor of electrical engineering in the Moore School of Electrical Engineering and has been serving as vice-dean of that school. He also is professor of radiologic physics in the school of medicine and associate professor of radiologic physics in the graduate school of medicine.

Dr. Hixson is professor of chemical engineering at the University and serves as a consultant to the Bethlehem Steel Company, Raw Products Division.

Appointed directors of the five engineering schools are Melvin C. Molstad, chemical engineering; Emory F. Stover, civil engineering; Lee N. Gulick, Mem. ASME, mechanical engineering; Robert M. Brick, metallurgical engineering, and John G. Brainerd, Moore School.

Dr. Molstad, Professor Stover, and Dr. Brick have been serving as directors of engineering departments at the University; Professor Gulick has been acting dean of the Towne School, and Dr. Brainerd formerly was chairman of the division of physical science in the Graduate School of Arts and Sciences.

In addition to providing for closer co-operation among the various engineering departments of the University, the reorganization is particularly significant in the provision which it makes for the creation of the new Institute for Co-Operative Research.

The increase in industrial activity in the Delaware Valley has been accompanied by a corresponding increase in the need for productive research, and the University of Pennsylvania is determined to play a major role in helping to meet this demand.

Women Students Admitted

Every educational division of the University of Pennsylvania will be open to women students with the beginning of the 1954 fall term.

This was assured when President Gaylord P. Harnwell announced that women undergraduates will be admitted to the Wharton School of Finance and Commerce and the engineering division of the University, which heretofore have restricted their undergraduate enrollment to men.

However, while women have been admitted to the graduate division of the Wharton School and to the graduate departments of the engineering division and the Moore School of Electrical Engineering, they have never before had the opportunity to enroll as undergraduates in these schools.

The Towne Scientific School was founded in 1875 and the Moore School of Electrical Engineering in 1923.

Meetings of Other Societies

May 16–19
American Institute of Chemical Engineers, national meeting, Kimball Hotel, Springfield, Mass.

May 17–18
Society of Naval Architects and Marine Engineers, spring meeting, Olympic Hotel, Seattle, Wash.

May 19–21
AIEE-AWS, fourth conference on electric welding, Hotel Schroeder, Milwaukee, Wis.

May 23–28
American Water Works Association, annual convention, Seattle, Wash.

May 26–27
American Iron and Steel Institute, sixty-second general meeting, Waldorf-Astoria Hotel, New York, N. Y.

June 1–3
Edison Electric Institute, twenty-second annual convention, Atlantic City, N. J.

June 6–11
Society of Automotive Engineers, summer meeting, Ambassador Hotel, Atlantic City, N. J.

June 7–10
The Society of the Plastics Industry, sixth national plastics exposition, Cleveland Auditorium, Cleveland, Ohio

June 9–11
American Society for Quality Control, eighth national convention, Kiel Auditorium, St. Louis, Mo.

June 13–18
American Society for Testing Materials, annual meeting, Sherman and Morrison Hotels, Chicago, Ill.

June 14–18
American Society for Engineering Education, annual meeting, University of Illinois, Urbana, Ill.

June 14–19
American Society of Civil Engineers, convention, Chalfonte-Haddon Hall, Atlantic City, N. J.

(ASME Calendar of Coming Events, see page 466)

ASME Oil and Gas Power Conference in Kansas City, Mo., June 14–17

With a technical program planned to interest and benefit pipe liners, power-plant operators, and all concerned with diesel, dual fuel, and gas engines, the twenty-sixth annual conference and exhibit of the Oil and Gas Power Division of The American Society of Mechanical Engineers is scheduled in the Muehlbach Hotel, Kansas City, Mo., June 14–17.

Highlighting the program will be technical papers on cooling-system problems; cooling equipment; foundations for pipe-line compressors; engine analyzers; turbocharging two-cycle engines; gas-transmission compressor cylinder-design trends, and pipe-line construction. There is also scheduled a technical session cosponsored by the ASME Gas Turbine Power Division on gas turbines in pipe-line pumping.

Of special interest will be a discussion of the proposed speed-governing specifications for engine-generator units, by W. L. H. Doyle, chairman of the subcommittee of the Joint AIEE-ASME Committee.

The program of technical meetings interspersed with exhibit-inspection periods starts 9:30 a.m. Monday, June 14. A Welcome Luncheon will be held at noon on Monday, a Banquet on Tuesday evening, and a buffet supper is scheduled for Wednesday evening. The program winds up with an interesting inspection trip Thursday, June 17.

Be sure to mention the ASME meeting when requesting reservations at the Muehlebach Hotel.

ASME Textile Engineering Division to Meet in Boston

The Textile Engineering Division of The American Society of Mechanical Engineers will meet at the Sheraton Hotel, Boston, Mass., on May 21, to discuss the latest available information on textile-machinery drives.

The morning session, commencing 9:30 a.m., features talks by R. E. Parker and F. D. Snyder, speaking on matching electrical characteristics to textile-machinery-drive requirements.

D. P. Campbell, associate professor of electrical engineering, Massachusetts Institute of Technology, and specialist in automation, will be guest speaker at the luncheon. His topic is "Automatic Controls in Materials Handling."

The afternoon session will be devoted to papers describing recent concepts of motivating textile machinery. R. H. Brown will give a talk on electric-motion control of textile machinery and Richard Palmer will take up electric mutiple-plate clutch. The papers cover automatic drives, with controlled start-and-stop at the operator's will or through automatic stop-motion control.

This important meeting is another ASME effort to bring the most recent and useful developments in this field to the attention of the textile industry.

Junior Forum . . .

Conducted by Joseph Schmerler, Assoc. Mem. ASME

Social Responsibilities of the Engineer

by Sherwood B. Menkes[1]

Perhaps Communism's most vicious and invidious aspect is its negation of the prerogative of individual choice which is the most treasured possession of the democratic state.

Among the various professions, engineering is the epitome of those in which the consequences of individual action are most clearly realized. The thought processes which must be undergone, such as the statement and consideration of a problem, followed by reflection on theory, applied research, investigation of source data, and the eventual conclusion, are all essentially best performed on an individual basis.

There is no criterion by which the efficiency of operation of an engineer can be properly evaluated. Therefore it is necessary for each engineer, as he approaches the practice of his profession, to develop an integrity of thought and action which will be a personal yardstick of his achievements. It is to be presumed that he will earnestly approach each new question with the desire to achieve the optimum result and eliminate from his consideration all questions of a personal and biased nature.

The first industrial revolution was a transfer of power from man to machine. This represented an immense widening of possibilities as far as an increase in productivity of the individual is concerned.

The second industrial revolution, which is presently continuing, represents largely a transfer of skill and a transfer of intelligence from man to machine. There are two immediate effects of this continuing transfer which play daily havoc with local segments of the working population.

The first problem concerns a local or temporary displacement of personnel by technological improvements. This has been variously argued elsewhere as a point against the continuation of progress. The obvious rebuttal, warranted by the evidence, is that the object of technical progress is to improve the standard of living by decreasing working hours, increasing the productivity of the individual, increasing leisure time, and widening

[1] Production engineer, Western Electric Company, Inc., Kearny, N. J. Assoc. Mem. ASME.

ASME Philadelphia Section praises "The Big Idea." At the Joint Junior-Senior Banquet Meeting, February 23, President L. K. Sillcox addressed the large group. Another high light of the event was the presentation over WCAU-TV, Philadelphia Channel 10, of certificates of merit to "The Big Idea" Program. G. M. Muschamp, Mem. ASME, *center,* presents the certificates to R. Stewart Rausch, Jr., *left,* executive vice-president, Philadelphia Saving Fund Society, sponsor of the program and Don Bennett, *right,* creator and producer of "The Big Idea" program.

the possible avenues of production. All of these are and have been actually accomplished by the process of continuing technological growth.

The second problem lies in the possible incidence of a cultural paralysis among those groups which are deprived of the exercise of their intelligence in their working occupations. While it is certainly true that factory jobs frequently become monotonous and stultifying, the development of more leisure time can lead, if we wish it to, to a wider application of the creative instinct in leisure activities. It may in part be the responsibility of the engineer to work to develop these desires for creative leisure activity in so far as he is able among the working groups with whom he comes in contact.

The rapid technological progress of the past quarter century has apparently far outstripped any attempt at moral evolution in the same period. The increase in potential energy of destruction without a consequent apparent increased ability to live peacefully with our neighbors and with each other makes all decisions in this area very dangerous ones. The solution to our present predicament is to encourage all men to live and conduct their individual businesses with high honor and integrity, so that the morals of the society will of themselves improve at a more rapid rate than heretofore. The engineer's area of responsibility here is significant because of his vastly increased importance in the present economy.

Philadelphia Section Activity—Associate Group

Contributed by George J. Kolsun[2]

The Associate Group of the Philadelphia Section of The American Society of Mechanical Engineers held its annual Sponsor-Student Night on Tuesday evening, February 23. At that meeting, sponsors who are responsible, experienced engineers were introduced to engineering students from the University of Pennsylvania, Villanova, Swarthmore, and Drexel Institute of Technology and were the students' host for the evening.

During dinner, television sets were tuned to the program, "The Big Idea," which honored National Engineers' Week. The Group awarded certificates to Don Bennett, director of "The Big Idea," and The Philadelphia Saving Fund Society, sponsor of the program. A certificate was awarded to past-chairman Robert W. Worley for his services during the 1952-1953 term, by present chairman, C. C. Franck. The meeting was then turned over to associate chairman, F. W. Convey, who introduced William McLean, vice-president of Region III, and President L. K. Sillcox.

President Sillcox delivered an inspiring address entitled, "Where Success Begins," based on the proposition that success is no accident and is achieved only through hard work. He called attention to the present and future demand for highly trained engineers, many of whom are being absorbed by management. He also termed as critical the lack of scientific instructors in high schools and colleges due to the incentives of industry. President Sillcox stressed the marks of leadership and how such qualities must be developed by constant effort and diligence. The President stated that the successful engineer's technical knowledge must be balanced by ability to work with management as well as those under his charge, and that development of qualities such as character, judgment, ambition, initiative, poise, and the like, play an important part in today's successful engineer.

The meeting was closed following President Sillcox's address, and another extremely successful Sponsor-Student Meeting full of good fellowship, guidance, and ASME activity was concluded.

[2] Mechanical engineer, Sun Oil Company, Philadelphia, Pa. Assoc. Mem. ASME.

Actions of the ASME Executive Committee

At a Meeting at Headquarters, March 18, 1954

A Meeting of the Executive Committee of the Council was held in the rooms of the Society March 18, 1954. L. K. Sillcox, chairman, presided. In addition to Mr. Sillcox, there were present: Willis F. Thompson and H. E. Martin of the Executive Committee; Joseph Pope, chairman, Finance Committee; V. Weaver Smith, chairman, Organization Committee; F. L. Bradley and Robert B. Lea, directors; C. E. Davies, secretary; and O. B. Schier, II, assistant secretary. T. F. Collier, of Westcott and Mapes, was present during part of the meeting to present a preliminary report on an Engineering Societies Work Center.

Free Coupons

The Secretary reported that 27,000 of the free coupons distributed in August, 1953, had been redeemed for papers. He requested decision on continuance of free distribution. The Committee voted to distribute ten free coupons to the members with the bill for dues in August, 1954.

Resolution of Thanks

The Committee voted a resolution of thanks in connection with the International Meeting in Mexico City, March 10-12, 1954, to all organizations and individuals who contributed to the success of the meeting.

State Line Subsection

The establishment of the State Line Subsection of the Buffalo Section was approved. The territory will include the counties of Allegany and Cattaraugus in New York State and McKean County in Pennsylvania.

New Student Branch

Establishment of an ASME Student Branch at Lowell Technological Institute of Massachusetts, Lowell, Mass., was approved.

Certificates of Award

Certificates of award were granted to the following retiring chairmen: E. L. Hopping, Board on Honors; and Karl B. McEachron, Jr., Education Committee.

The following retiring chairman of Sections were also granted certificates of award: A. Sidney Norton, Eastern North Carolina; and Charles A. Dewey, Jr., Piedmont-Carolina.

New Engineering Societies Building

The Secretary reported that on March 2, 1954, at the direction of the Special Council Committee on Engineering Societies Building, a communication had been sent to the firm of Westcott and Mapes, New Haven, Conn., retaining a member of that organization to prepare a study for a work center for the ASME and other societies within an approximate radius of 25 miles from New York City. T. F. Collier presented a preliminary report to the Committee. A more complete report to be ready in April.

The American Institute of Electrical Engineers had invited the Board or Council of the Founder Societies and the American Institute of Chemical Engineers to join the Board of Directors of AIEE in an inspection of the proposed building sites in Chicago, Ill., in April. ASME will be represented by the President, several members of the Council, and the secretary.

Undergraduate Student Award

The recipient of the 1953 Undergraduate Student Award, Robert M. Bell, is located in England and it was not possible to present the Award in person to Mr. Bell at the 1953 Annual Meeting. The Institution of Mechanical Engineers (London) was requested to make the presentation. The Committee was advised by letter, dated March 8, that the presentation had been made at the IME General Meeting in February.

Presidential Appointments

The following presidential appointments were confirmed:

Gordon Hahn to New York State Society of Professional Engineers, Testimonial Dinner, March 24, 1954.

R. E. Derby and James A. Quaid to Annual Meeting of American Academy of Political and Social Science, April 2-3, 1954.

Leon G. LePaige to 25th anniversary celebration, De Vlaamse Ingenieursvereniging, Antwerp, Belgium, June 14-19, 1954.

Engineering Societies Personnel Service, Inc.

These items are from information furnished by the Engineering Societies Personnel Service, Inc., in co-operation with the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to all engineers, members, or nonmembers and is operated on a nonprofit basis.

In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrant members whose availability notices appear in these columns. Apply by letter, addressed to the key number indicated, and mail to the New York office.

When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available at a subscription of $3.50 per quarter or $12 per annum for members, $4.50 per quarter for nonmembers, payable in advance.

New York	Chicago	Detroit	San Francisco
8 West 40th St.	84 East Randolph St.	100 Farnsworth Ave.	57 Post St.

Men Available[1]

Mechanical Engineer, 35, BSME, BS Adm. Engr., experienced in production engineering, purchasing; project engineer on special assignment. Desires sales engineering, liaison engineering, or position ultimately leading to management. Will relocate. Me-74.

Industrial Engineer, 30, BSIE, married, four years' experience in methods and development in textile industry. One year's experience in design and layout of piping systems. Desires permanent position in methods or development with manufacturing concern. Prefers northern N. J. Me-75.

Mechanical Engineer, 33, BME, BS Marine Engineering, 13 years' diversified experience in initial operation and trouble-shooting of power plants, personnel training, equipment evaluation, research, and development. Me-76.

Project Engineer, 36, BME, married, two children, 16 years' experience research, design, development of textile equipment, desires administrative position or equivalent in textile or other field. Will relocate. Salary open. Me-77.

Mechanical Engineer, BSME, 39, executive background; 18 years' wide experience design of special machinery, automotive, tractor, hydraulics, rubber, production equipment, as design engineer and consultant. Responsible administrator. Registered Ill., Colo., Texas, Ga., Okla. "Who's Who Commerce and Industry." Me-78.

Sales-Service Engineer, 25, married, young industrial engineer, ability to work with people, desires field position where engineering background can be utilized to advantage. Five years' experience in materials handling, equipment, design, and selection. Desires association with mechanical-equipment manufacturer on West Coast, but no limitation. San Francisco. Me-79-5212-D-3

Graduate Assistant, BSME, MS, 26, desires teaching position in heat-power field. Experience in teaching, research, and industry. Will locate anywhere in United States. Available in June. Me-80.

Mechanical Engineer, PhD, interested in applied mechanics and applied mathematics, seeking work with a progressive company or teaching position. Me-81.

Mechanical Engineer, PE, N. Y., design, estimating, supervision, chemical plants, process-equipment, pressure vessels, materials-handling equipment, mechanical, structural designer, aircraft designer, liaison engineer, supervisor. Desires supervisory position. Me-82.

Mechanical Engineer, 38, MSME, LLB. Presently employed as power engineer. Desires opportunity to combine law and engineering or teaching position. Me-83.

Executive Engineer, 46, chemical, mechanical, electrical, civil registration by exams. Experienced chief engineer and technical director pulp-paper mills. Graduate education equivalent to advanced degree. Past five years over 100 men in power and maintenance. Also charge of $3,500,000 expansion and modernization program. Me-84.

Manufacturing Engineer, 32, mechanical engineer; MSIE, eight years' experience in textiles and chemical field, including all phases of industrial engineering. Supervision of production personnel. Willing to do some traveling. Eastern headquarters desired. Me-85.

Mechanical Engineer, 30, BME, MME, PE, married, five years' experience utility-power plant design and construction. Presently assistant project engineer. Desires responsible position with small or medium-size company in power or related field. Will relocate. Me-86.

Mechanical Engineer, 26, BME, 1949, married, three years U. S. Army; one year Korea. Major heating, ventilating, and air conditioning. Can start work immediately. Me-87.

Chief Engineer, BME, 31, married. Extensive progressive die, jig, and fixture experience in precision production. Machines designed for automatic manufacturing using conveyers, dial feeds, chutes, and hopper feeds. Important supervisory experience. Cost-conscious. Me-88.

[1] All men listed hold some form of ASME membership.

Positions Available

Engineers. (*a*) Junior mechanical engineer, recent graduate, for liaison, test, development engineering on controls. $3900. (*b*) Field-service engineer, preferably single, for instrument-service work. $4680–$5200. (*c*) Sales engineer, mechanical graduate, aircraft experience for contract, specification, quotation work. $4620–$4680. (*d*) Methods engineer, industrial, mechanical, or electrical, machine-shop and general manufacturing experience on electro-mechanical devices. $5200. N. J. Y-9780.

Plant Engineer, 35–45, mechanical graduate, plant-engineering and maintenance experience covering steam-power generation, electrical distribution, heating, water supply, etc., to assist superintendent of buildings and grounds at educational institution. $6000–$8000. Western N. Y. State. Y-9781.

Research and Development Engineer, mechanical or chemical graduate, at least five years' experience on distillation, evaporation, and refrigeration equipment and processes to supervise water-purification and reclamation project. $8360. Washington, D. C. Y-9796.

Project Engineer, mechanical graduate, design and development experience on engine accessories, preferably in jet-engine field for design and development of thermocouple devices and accessories. $6000–$8000. New York, N. Y. Y-9804.

Designer, mechanical, five to ten years' experience on the design of small automatic machinery. Will supervise several draftsmen. Temporary, six-months' work; possibility of permanent employment. $7200–$7800. New York, N. Y. Y-9817.

Sales Engineer, 30–40, mechanical or electrical graduate, at least five years' sales experience in auto-parts and accessories fields, to sell stampings and metal products. $10,000–$12,000. Mich. Y-9820–D–9223.

Maintenance Engineer, young, mechanical graduate, for plant engineering and maintenance in vegetable-oil plant. $4200–$4800. N. J. Y-9821.

Sales Engineer, degree in mechanical engineering preferred. Previous selling experience of heavy industrial equipment or a little mechanical-engineering experience helpful. Work involves corresponding with prospective customers in answer to inquiries for equipment, consulting with prospective customers on their straightening problems, and preparing difficult and lengthy quotations. $4500–$5000. Pa. Y-9823.

Designers, not over 50, mechanical-engineering degree, and several years' experience in designing heavy machinery, preferably industrial machines. Who are specializers in roll-mill straighteners, extrusion presses, hydraulic stretchers, and sheet levellers, gag presses, and heavy-duty universal joints for processing seamless and welded tubes and pipes, etc. Work involves layout and design of heavy mill machinery. Will help develop new improved designs of existing machinery and aid in the creation of machines in additional fields. Security clearance must be obtained. $4500–$6000. Pa. Y-9824.

Chief Engineer, 35–45, mechanical or electrical graduate, at least five years' design, development, and application experience covering medical instruments, vibration analyzers, and oscillographic equipment. $10,000. Mass. Y-9848.

General Manager, 45–55, for leading manufacturer of tools and machines used by general contractors, highway contractors, industrial plants, and municipalities. Must be experienced in every phase of the machine and tool business rather than specialized in certain departments. Must be able to handle all ramifications of a large manufacturing and assembling plant. Actual selling experience required. Up to $35,000. East. Y-9860.

Mechanical Engineer, at least five years' machinery and equipment experience in export field. Must speak Spanish. $6000–$10,000. New York, N. Y. Y-9862.

Secretary to Administrative Committee, 30–35. Should have editorial or writing background, to write up improvement projects for multiplant operation consumer-goods industries. Salary open. New York, N. Y. Y-9871.

Tool and Production Engineer, wide experience in tooling and manufacturing of precision-metal products. Knowledge of product design (aircraft, hydraulic, and pneumatic) desirable. Salary open. N. J. Y-9874.

Chief Engineer, 35–50, mechanical graduate, at least ten years' metal-fabrication experience, to take charge of product design, equipment, plant layout, and general engineering duties. $10,000–$15,000. Ill. Y-9876.

Plant-Layout Engineer, considerable experience in production line setup as well as materials-handling background. $7800–$8400. Md. Y-9877.

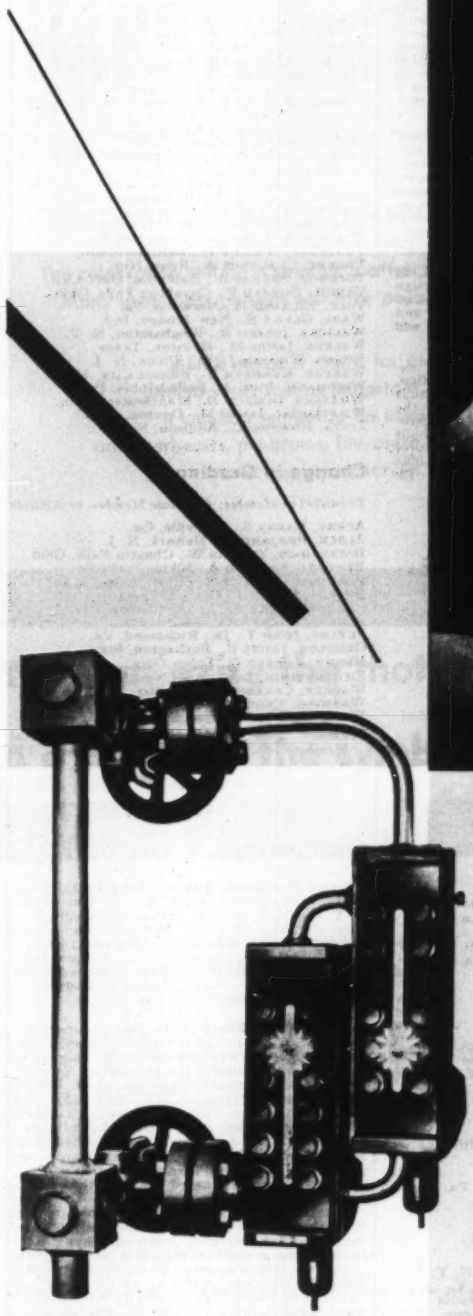
Staff Industrial Engineer, 35–45, engineering graduate, at least five years' successful experience in industrial engineering covering plant layout, materials-handling, packaging, and general cost-reduction work in process industry. $9000–$10,000. Westchester County, N. Y. Y-9880.

Elevator Engineer, 30–35, mechanical or electrical degree, five to seven years' experience in the manufacture of elevator equipment or similar equipment. Will be responsible for co-ordinating the engineering requirements of the firm, the activities of his own staff, and the work of subcontractors so as to conform to the requirements of the customers. Company specializes in the repair and manufacture of elevator equipment and in the modernization of existing elevator installations. Applicant must be familiar with various types and their uses, and the methods of modification to meet code requirements. $7500. New York, N. Y. Y-9885.

Chief Industrial Engineer, 35–45, for major textile manufacture. Textile background not absolutely essential, but preferred. Should be qualified to handle the responsibility connected with such a position. $12,000. New York, N. Y. Y-9886.

Engineers. (*a*) Designer, 30–45, graduate, five to ten years' experience in design of heavy equipment, preferably tractors and crawlers. Duties involve designing off-the-axle equipment

(*ASME News continued on page 478*)



Yarway High Pressure Boiler Water Gage with separated-design flat glass inserts. Write for Yarway Bulletin WG-1812.

HE'S A SPECIALIST ON STAINLESS STEEL INLAYS

● A dentist? No.

He's a Yarway craftsman. In the picture above he is milling a gasket groove in the stainless steel facing that is used for this important part of a high pressure boiler water gage body.

The man is important; so is the inlay.

The man is typical of the skilled workmanship that goes into every Yarway gage, blow-off valve, steam trap or other product —workmanship that makes no compromise with quality.

The stainless steel facing is typical of advanced Yarway engineering design. That inlay is but one of twelve basic improvements made in Yarway high pressure water gages.

When buying boiler water gages as well as other steam plant equipment, measure the cost in terms of good engineering, quality, workmanship, and dependable service.

"Make Yarway your way."

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
Branch Offices in Principal Cities

YARWAY

steam plant equipment

BLOW-OFF VALVES
WATER COLUMNS AND GAGES
REMOTE LIQUID LEVEL INDICATORS
EXPANSION JOINTS
DIGESTER VALVES
STEAM TRAPS
STRAINERS
SPRAY NOZZLES

or a manufacturer of tractors. $7200, and up. Employer will pay fee. (*b*) Test engineer, mechanical graduate, over 26, two or three years' experience in testing or designing automotive equipment. Duties involve 50 per cent of time spent in field analyzing performance of experimental machines, investigate complaints, instruct users, etc.; balance of time in plant preparing reports of field observations, some design of fixtures, and product changes. Handle correspondence on test equipment. $6000, and up. Employer will pay fee. Ill. C-1743.

Engineers. (*a*) Design-test engineer, mechanical or electrical, broad knowledge of general technical field of engineering. Will test parts, materials, devices, and models to insure high degree of performance and service for a manufacturer of controls. $4680–$7200. Employer will pay fee. (*b*) Methods, time-study engineer, industrial or equivalent experience. Two or more years' experience in tool and diemaking. Will establish guaranteed standards by time-and-motion techniques or any operation or function for a manufacturer of controls. $4680–$6240. Employer will pay fee. Minn. C-1747.

Development Engineer, up to 45, mechanical, at least five years' experience in development or design of equipment applicable to dairy industry. Knowledge of dairy processing helpful. Duties involve development of dairy equipment and machinery for a manufacturer of dairy equipment. $6000–$7200. Moving expenses or placement fee paid. Upstate New York. C-1767(*b*).

Administrative Engineer, 35–40, mechanical or electrical, at least five years' experience in processing screw-machine or stamping products. Knowledge of foundry operations and practices. Will co-ordinate engineering and production activities covering drawing changes, ways to make a product, and manufacturing costs for a manufacturer of electrical products. $10,000. Ill. C-1776.

Project Engineer, 30–40, at least three years' experience in design and development of unit heaters (sheet-metal fabrication) or heating coils and air conditioning (heat transfer). Knowledge of tooling and processing. Will do project work on heating coils, air-conditioning units, or heat convectors for a manufacturer of metal products. $6000–$8000. Employer will negotiate fee. Ill. C-1778.

Product Engineers, mechanical, electrical, or chemical, up to ten years' experience in design and development. Will do design and development on automatic controls—pressure-liquid and level controlled. $4500–$8400. Employer will negotiate fee. Iowa. C-1786.

Shop Superintendent, at least five years' experience in industrial-refrigeration production. Knowledge of neon, welding, and custom-built job-shop-type production. Will supervise the manufacture of custom-built industrial refrigeration units, ice rinks, and other specially built equipment of a similar nature, for a manufacturer of industrial refrigeration. Up to $15,000. Employer will negotiate placement fee. Ill. C-1813.

Candidates for Membership and Transfer in the ASME

The application of each of the candidates listed below is to be voted on after May 25, 1954, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the Secretary of The American Society of Mechanical Engineers immediately.

Key to Abbreviation

R = Re-election; Rt = Reinstatement; Rt & T = Reinstatement and Transfer to Member

New Applications

For Member Associate Member, or Affiliate

AIKEN, RUDOLPH W., Woodhaven, N. Y.
ALFIERI, GIULIO, Modena, Italy
ANDERSON, CARL H., Longmeadow, Mass.
ANKERS, GEORGE M., Staten Island, N. Y.
ARNOLD, JOHN H., New York, N. Y.
AUSTIN, PAUL P., San Francisco, Calif.
AYLARD, WILLIAM F., Waterbury, Conn.
BAKKEN, STEWART E., Midland, Texas
BARKER, EARLE L., New York, N. Y.
BECK, JOSEPH J., Berlin, Wis.
BILLMAN, GEORGE H., Erie, Pa.
BINGENHEIMER, CHARLES G., Burlington, N. C.
BOGGS, EUGENE W., Savannah, Ga.
BOREOWSKI, STANISLAW, New York, N. Y.
BOULGER, FRANCIS W., Columbus, Ohio
BRANDO, ROBERT J., Ann Arbor, Mich.
BRENNAN, PATRICK J., La Canada, Calif.
BRENNAN, THOMAS J., Astoria, L. I., N. Y.
BRINCKERHOFF, GILBERT G., JR., Reading, Pa.
BROWN, HARRY C., Surrey, England
BUGG, WAYNE F., Woodbury, N. J.
CARTWRIGHT, KENNETH O., Glendale, Calif.
CARY, FRANCIS H., Providence, R. I.
CHOUDHURY, AKSHAY P. D., Philadelphia, Pa.
CODY, FREMONT R., Bothell, Wash.
CORIN, PHILIP G., Yorkshire, England
COWLIN, CHRISTOPHER J., Philadelphia, Pa.
DAVIES, EDWARD T., Blakely, Pa.
DAVIS, ROBERT J., Baytown, Texas
DENOLER, MAX A., Hawthorne, Calif.
DEVINE, ALOYSIUS J., Arlington, N. J.
DICKINSON, BEN W. O., 3RD, Santa Monica, Calif.
ENGRMAN, ROBERT F., McDonough, Ga.
FARLEY, WIRT, San Francisco, Calif.
FIGARI, ERNEST B., Beaumont, Texas
FIKENSCHER, FRIEDRICH C., Gummersbach, Germany
FIORETTI, ANDRIANO P., Cincinnati, Ohio
FOLSOM, JAMES P., Wilmington, Del.
GEOFFROY, ROBERT, Brussels, Belgium
GODFREY, DONALD R., Sharon, Pa.
HAGSTROM, CARL R., Jamestown, N. Y.
HALE, DONALD B., Groves, Texas
HALLIDAY, JOHN J., River Forest, Ill.
HAMILTON, CARL C., Alliance, Ohio
HANSEN, EDWARD H., Bayside, N. Y.
HARRISON, ALBERT R., Snyder, N. Y.
HEISLER, MICHAEL P., Whittier, Calif.
HENSLEE, SELDEN W., Texas City, Texas
HERZ, JOSEPH E., Newtown, Pa.
HESS, PAUL J., Schenectady, N. Y.
HOHL, FRANK J., Eggertsville, N. Y.
HOVENGA, RICHARD E., Los Angeles, Calif.
HOYT, WILLIAM M., New York, N. Y.
IGNATUK, RICHARD S., Syracuse, N. Y.
IRION, EDWARD C., Oaklyn, N. J.
JARRETT, JAMES R., St. Albans, W. Va.
JASZCZAK, CZESTAW S., Hamilton, Ont., Can.
JENSEN, JORGEN A., Hartsdale, N. Y.
JONES, JOHN E., Horseheads, N. Y.
KALLO, STANLEY P., Beaverton, Ore.
KALWITZ, MYLES F., Arlington Heights, Ill.
KAMARCK, FRANK M., New York, N. Y.
KAPLAN, SAMUEL X., Sioux City, Iowa
KATT, WILLIAM J., St. Louis, Mo.
KEEFE, DANIEL A., Walnut Creek, Calif.
KENDALL, ROBERT E., Weston, Mass.
KING, GORDON R., Baytown, Texas
KING, LOUIS T., Phoenix, Ariz.
KLINE, WALTER W., Mt. Healthy, Ohio
KNIGHT, JOHN T., JR., New Orleans, La.
KNOHL, KARL, Hinsdale, N. Y.
KOROLENKO, VLADIMIR G., Syracuse, N. Y.
KOZLOWSKI, EDWARD J., Milford, Conn.
KRAMER, NATHAN R., Bronx, N. Y.
KRAUSE, GERHARD P., Harrison, N. Y.
KREIDER, DAVID B., Somerville, N. J.
KRIDER, PAUL A., Akron, Ohio
KROSS, WILLIAM J., Chicago, Ill.
LAMBERT, ESTERN R., JR., Chattanooga, Tenn.
LA TOUR, ROBERT W., Cincinnati, Ohio
LAWRENCE, LOUIS L., Newburgh, N. Y.
LENZ, CARL, JR., Tinley Park, Ill.
LIPSTEIN, NORMAN J., Schenectady, N. Y.
LOVEN, HIPPOLYTE G., Mount Vernon, N. Y.
LUCHT, HAROLD C., Kenmore, N. Y.
LUFKIN, CLARENCE R., San Diego, Calif.
MAHER, PAUL L., Utica, N. Y.
MAJEWSKI, FRANK T., Dover, Del.
MARKLE, HARRY A., JR., Catasauqua, Pa.
MASSEY, ERNST M., New York, N. Y.
MCBRIDE, SAMUEL, Omaha, Neb.
METZ, THOMAS W., Indianapolis, Ind.
MILES, BRUCE W., White Plains, N. Y.
MINTZ, NATHAN H., Brooklyn, N. Y.
MONTELONE, EUGENE N., New York, N. Y.
MOSKOWITZ, MILTON, Forest Hills, N. Y.
MUKHERJIS, BASANTA K., Khandwa, India
MURASKA, ANTHONY S., Waterbury, Conn.
MYNTTI, DONALD C., Virginia, Minn.
NESHER-ADLER, MOSHE E., Givataim, Israel
NEUBERGER, ROGER B., San Francisco, Calif.
NIELSEN, HERLUF P., Pasadena, Calif.
NORDQUIST, ERIC A., Leavenworth, Wash
PARRATT, CHARLES O., Lakewood, Ohio
PELLIKKA, HENRY J., Midland, Mich.
PELTON, HARRY A., Los Angeles, Calif.
PETERSON, ELMER O., Hingham, Mass.
POPE, MICHAEL, New York, N. Y.
PRICE, CHARLES E., Franklin, Ind.
REED, EDWIN E., Bartlesville, Okla.
REEVE, PAUL G., Houston, Texas
REUSING, MATTHEW J., Clifton Heights, Pa.
ROSS, BERNARD E., Nashville, Tenn.
ROTHE, OSCAR H., El Dorado, Ark.
ROWAN, MILES J., Wellesley, Mass.
ROWLAND, WILLIAM C., Philadelphia, Pa.
RUDNICKAS, VITTE W., Vestal, N. Y.
RUSSELL, WALTER H., Hartford, Conn.
SALVADORI, MARIO G., New York, N. Y.
SCHARBROUGH, JAMES A., Indianapolis, Ind.
SCHMIDT, WALTER F., Gummersbach, Germany
SCOLARO, DOMINICK R., Brooklyn, N. Y.
SCRUGGS, SAMUEL Y., Kenova, W. Va.
SENYK, JOSEPH, Pittsburgh, Pa.
SHARTRAND, GEORGE J., Schenectady, N. Y.
SHATZKY, JACOB, Bayonne, N. J.
SHAW, THOMAS L., Costa Rica, Central America
SHIRESS, KEITH S., North Rhodesia, Africa
SIEVERDING, WAYNE F., Marshalltown, Iowa
SORENSEN, ARTHUR S., JR., Milwaukee, Wis.
TEMPLETON, HAROLD C., Lebanon, Pa.
THATCHER, WESLEY D., Baltimore, Md.
THORNE, CLARENCE A., Reno, Nev.
TODOROV, ATANAS A., Hamilton, Ont., Can.
VANICA, DONALD F., Cuyahoga Falls, Ohio
VOLK, RICHARD H., Norwood, Pa.
WADE, GLENN E., New Albany, Ind.
WALICKE, JOSEPH R., Binghamton, N. Y.
WALKER, JAMES M., Houston, Texas
WALSH, WILLIAM J., JR., Union, N. J.
WEAVER, KENNETH E., Ellicott City, Md.
WIEDMANN, JOHN A., Philadelphia, Pa.
WILLIAMS, DONALD D., Manchester, Tenn.
WILLIAMSON, JAMES M., Dayton, Ohio
ZINTA, HOWARD C., Addison, N. Y.

Change in Grading

Transfers to Member, Associate Member, or Affiliate

ACKEY, HARRY S., Rossville, Ga.
ALECK, BENJAMIN J., Newark, N. J.
BAINBRIDGE, THOMAS W., Chagrin Falls, Ohio
BENNETT, RICHARD A., Elkins Park, Pa.
BORCHER, CHARLES A., Silver Spring, Md.
BUTLER, FRANK J., Orange, Texas
CUSHMAN, JOHN A., JR., Reedsville, Pa.
FARKAS, ANDREW G., Somers, Conn.
FLYTHE, JOHN T., JR., Richmond, Va.
GUGELER, JAMES E., Burlington, Iowa
HENRY, ROBERT L., Tulsa, Okla.
LICHTENSTEIN, IMMANUEL, New York, N. Y.
WAGNER, CLARENCE E., Snyder, N. Y.
WARMING, THORLS, Milwaukee, Wis.
WHELESS, EAKIN L., JR., Shreveport, La.

Transfers from Student Member to Associate Member 150

Obituaries . . .

Percy Prettyman Bowen (1893–1953), president, International Filler Corp., Tonawanda, N. Y., died Aug. 28, 1953. Born, Hyattsville, Md., Aug. 6, 1893. Parents, Percy C. and Laura (Dodd) Bowen. Education, graduate, Technical High School, Washington, D. C.; 2 years, Polytechnical Institute of Brooklyn. Married Katherine Cox, 1916; children, Helen J., Richard W. Mem. ASME, 1931.

Carl Franklin Braun (1884–1954), founder and president, C. F. Braun & Co., Alhambra, Calif., one of the nation's largest companies building oil refineries and chemical plants, died at Huntington Memorial Hospital, Pasadena, Calif., Feb. 4, 1954. Born, Oakland, Calif., July 15, 1884. Parents, Carl A. and Leonora (Campbell) Braun. Education, ME, Stanford University, 1907; LLD, Occidental College. Married Winifred Gilbert, 1909. The Braun Company constructed at Baytown, Texas, the nation's largest toluene plant, which turned out more than half of the TNT used in bombs dropped by the Allied Forces in World War II. The company also built the world's first synthetic-glycerine plant near Houston and first produced ethyl alcohol from petroleum derivatives. Hon. Mem. ASME, 1948. He was a member of Sigma Xi and Tau Beta Pi. He was a trustee of the California Institute of Technology; director, Friends of the Huntington Library; trustee, Claremont Men's College; consulting professor, the Stanford Graduate School of Business. Author of more than a score of books on management, leadership, and human relations. Survived by wife; three sons, C. Allan, John G., Henry A., of Pasadena; and five grandchildren.

Harold Sydney Fielder (1888–1953), director of the New Products Planning Group, Cherry-Burrell Corp., Chicago, Ill., died Dec. 16, 1953. Born, Chicago, Ill., Aug. 28, 1888. Education, graduate, Crane Technical High School, 1908; 3 years, University of Illinois. Mem. ASME, 1944. Author of several technical papers on

(*ASME News continued on page 480*)

HAPPY BIRTHDAY....COMING UP

Next year—1955—ASME will celebrate its 75th anniversary. The celebration will be a year-long affair. Many prominent persons will take part.

ASME needs a motto for its jubilee year. Just as important, it needs a symbol to be used on letterheads, programs, literature, and display materials.

You can write the motto

You can design the symbol

You don't have to be a writer or an artist. Plain language will count for more than literary style. Clear thinking will count for more than elaborate sketches.

For rules and helpful hints on how to prepare your entry, fill out and send in the coupon below.

SEND BEFORE MAY 21, 1954

ASME WILL PAY $250 FOR THE BEST MOTTO

$250 FOR THE BEST SYMBOL

MAIL TO: 75th Anniversary Committee
THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
29 West 39th Street, New York 18, New York

NAME_____

ADDRESS_____

CITY_____ ZONE_____ STATE_____

SECTION OR STUDENT BRANCH_____

milk plants; conducted courses on the subject at the University of Illinois; also held patents on equipment used in this field. He served as chairman of the Technical Committee of the Dairy Industry Supply Association and was an active leader in the 3A Standards work of the Sanitary Standards Subcommittee of the Dairy Industry Committee.

Keep Your ASME Records Up to Date

ASME Secretary's office in New York depends on a master membership file to maintain contact with individual members. This file is referred to dozens of times every day as a source of information important to the Society and to the members involved. All other Society records and files are kept up to date by incorporating in them changes made in the master file.

From the master file are made the lists of members registered in the Professional Divisions. Many Divisions issue newsletters, notices of meetings, and other materials of specific interest to persons registered in these Divisions. If you wish to receive such information, you should be registered in the Divisions (no more than three) in which you are interested. Your membership card bears key letters opposite your address which indicate the Divisions in which you are registered. Consult the form on this page for the meaning of the letters. If you wish to change the Divisions in which you are registered, please notify the Secretary's office.

It is important to you and to the Society to be sure that your latest mailing address, business connection, and Professional Divisions' enrollment are correct. Please check whether you wish mail sent to home or office address.

For your convenience a form for reporting this information is printed on this page. Please use it to keep the master file up to date.

ASME Master-File Information

(Not for use of student members)

Please print **Check mailing address**

Name..... (Last, First, Middle)

Home address..... ☐ (Street, City, Zone, State)

Name of employer.....

Address of employer..... ☐ (Street, City, Zone, State)

Product or service of company.....

Title of position held.....

Nature of work done.....

I am a subscriber to (please check)

Publication	*Address changes effective when received prior to:*
☐ Mechanical Engineering	10th of preceding month
☐ Transactions of the ASME	20th of preceding month
☐ *Journal of Applied Mechanics*	20th of preceding month
☐ *Applied Mechanics Reviews*	1st of preceding month

Please register me in three Professional Divisions as checked:

☐ A—Aviation	☐ J—Metals Engineering	☐ S—Power
☐ B—Applied Mechanics	☐ K—Heat Transfer	☐ T—Textile
☐ C—Management	☐ L—Process Industries	☐ V—Gas Turbine Power
☐ D—Materials Handling	☐ M—Production Engineering	☐ W—Wood Industries
☐ E—Oil and Gas Power	☐ N—Machine Design	☐ Y—Rubber & Plastics
☐ F—Fuels	☐ P—Petroleum	☐ Z—Instruments and Regulators
☐ G—Safety	☐ R—Railroad	
☐ H—Hydraulics		

John Anthony Garrett (1877–1953), mechanical and sales engineer, Fairbanks, Morse & Co., Los Angeles, Calif., died Dec. 10, 1953. Born Portland, Mo., November, 1877. Education, BS, University of Michigan, 1904. Mem. ASME, 1918.

Edward Gottlieb (1899–1952), patent attorney, New York, N. Y., died May 7, 1952, according to a notice recently received by the Society. Born, New York, N. Y., Nov. 18, 1899. Parents, Samuel and Lena Gottlieb. Education, BSME, Cooper Union, 1921; LLB, Columbia University. Married Julia Tauber, 1932. Jun. ASME, 1921; Assoc.-Mem. ASME, 1927; Mem. ASME, 1935. Survived by wife, mother, a sister, Valey; and three brothers, David, Martin, Joseph.

Charles Robert Hixon (1884–1954?), whose death was recently reported to the Society, was head professor in the Mechanical-Engineering Division, Alabama Polytechnic Institute, Auburn, Ala. Born, Perote, Ala., Dec. 7, 1884. Parents, D. Alexander and Juliet Evelyn (Petty) Hixon. Education, BS(ME), Alabama Polytechnic Institute, 1908. Married Hassie Earl Terrell, 1916 (deceased); children, Emily E., Charles R., Jr. (deceased). Married 2nd, Mrs. Dorothy G. Mitchell, 1940. Mem. ASME, 1921.

Albert Pierce Johnson (1926–1954?), industrial engineer, Green Fuel Economizer Co., Inc., Beacon, N. Y., died, according to a notice recently received by the Society. Born, Beacon, N. Y., Oct. 29, 1926. Education, BME, Clarkson College of Technology, 1947. Jun. ASME, 1947.

Wayne Sherwood McKee (1894–1953), assistant professor, mechanical engineering, Carnegie Institute of Technology, Pittsburgh, Pa., died Aug. 1, 1953. Born, Sherwood, Ohio, Nov. 13, 1894. Parents, William I. and Mary J. McKee. Education, BS, Carnegie Institute of Technology, 1934. Married Mildred Painter, 1930. Mem. ASME, 1939. Author of technical papers published in professional journals.

Neal Albert Melick (1880–1953), consulting engineer, Tampa, Fla., died Nov. 23, 1953. Born, Roseville, Ohio, May 6, 1880. Parents, Frank F. and Carrie M. (Padgett) Melick. Education, CE, Ohio State University, 1900. Married Harriette H. Johnson, 1906. Mem. ASME 1920.

Frank Ernest Moore (1877–1954), president Mathews Conveyer Co., Ellwood City, Pa., died Feb. 6, 1954. Born, Oswego, N. Y., July 30, 1877. Parents, James L. and Ester L. (Gates) Moore. Education, common school; ICS. Married Edith Brown, 1928. Assoc. ASME, 1919. He served the Society in the Materials Handling Division.

Albin James Nott (1882–1952), engineer, Colgate-Palmolive-Peet Co., Jersey City, N. J., died July 29, 1952, according to information recently received by the Society. Born, New Orleans, La., Sept. 22, 1882. Parents, James and Corinne (Bouligny) Nott. Education, BE, Tulane University, 1904. Jun. ASME, 1910; Mem. ASME, 1917.

Henry Meyer Robinson (1896–1954), engineer and technical adviser, Fort Worth Regional Office, Federal Power Commission, died Feb. 9, 1954, at his home in Dallas, Texas. Born, New York, N. Y., June 16, 1896. Parents, Henry and Josephine L. (Raddick) Robinson. Education, Stevens School; Stevens Institute of Technology, 1916; U. S. Naval Academy, Ensign, USN (engineering), 1918; graduate studies at Columbia University and the University of Texas. Married Helen E. Simon, 1919. He was awarded the Distinguished Service Medal for Valor during World War I. Jun. ASME, 1927; Mem. ASME, 1931. Served as chairman of ASME War Production Conference for Texas and Oklahoma; also chairman, ASME War Production Technical Committee for Texas and Oklahoma. Author of book entitled, "Public Utilities and the People," and several other books on utility engineering. Survived by wife; a son, Eldred J.; his mother; four brothers, Robert E., Shreveport, La.; Col. Alfred A., Arlington, Va.; Francis, Summit, N. J.; Theodore, New York, N. Y.; and a sister, Mrs. Clifford Gibson, Wallingford, Vt.

John Brewster Willis (1916–1954), consulting engineer and for more than a year a member of the South Miami (Fla.) Zoning board, died Jan. 6, 1954. Born, San Francisco, Calif., Feb. 5, 1916. Education, BS(ME), The George Washington University, 1940. Jun. ASME, 1940; Mem. ASME, 1953. Survived by wife, Mrs. Jean Willis; a son, John B.; a daughter, Ann B., all of South Miami; and a brother, Laurie S., St. Louis, Mo.

KIEKHAEFER

MERCURY

15th Anniversary Models

G.S. GEARS FOR 15 YEARS

Gearing of *finest* quality has always been demanded by KIEKHAEFER Corporation of Fond du Lac. Extreme accuracy and rigid adherence to critical specifications have applied from the first MERCURY made, to the brilliant 1954 line. Throughout "Fifteen Fabulous Years" G. S. Gears have helped MERCURY gain a position of quality leadership unequalled in the history of the industry!

Big features of the "Mighty Mark 50" pictured here, are new standards of speed, power and performance. 4 cylinders . . 40 horsepower . . *today's most powerful outboard!* To take speed and power like that, successfully, *the Gearing has to be good!*

Congratulations to KIEKHAEFER Corporation on the occasion of their 15th Anniversary. We at G. S. are thankful for the opportunity to serve.

GET OUR *Free* 6-PAGE FOLDER

See where and how we mass-manufacture Small Gearing to uniformly fine tolerances. This attractively printed 8½ x 11" 6-page folder is punched for ring-binder use. You'll want to keep it handy for frequent reference. It contains 23 pictures of Small Gears, plant views, as well as Diametral and Circular Pitch Tables. Ask for your copy on company stationery, please!

FRACTIONAL HORSEPOWER

GS

GEAR Specialties, Inc.

2635 WEST MEDILL AVENUE
CHICAGO 47, ILLINOIS

SPURS • SPIRALS • HELICALS • BEVELS • INTERNALS
WORM GEARING • RACKS • THREAD GRINDING

WORLD'S LARGEST EXCLUSIVE MANUFACTURERS OF FRACTIONAL HORSEPOWER GEARING

for lower cost control of moderately **Corrosive** fluids

Fig. 2651-A Gate

JENKINS

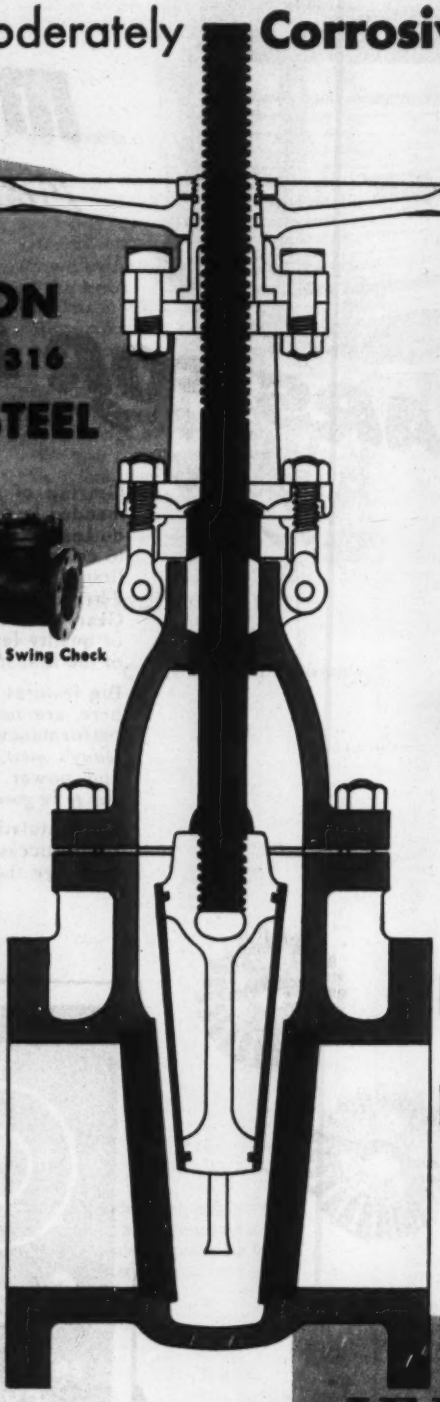
NICKEL IRON

Valves with Type 316

STAINLESS STEEL

Trim

Fig. 2624 Swing Check



Every part in contact with fluid is the right metal to block corrosion and beat wear.

- **BODIES** Heavy duty, dimensioned for greater resistance to wear and abuse. Through port design in Gate Valves.
- **BONNET** Rugged construction, like body. Swing-type gland bolts. Screwed-in back-seating bushing. Deep stuffing box.
- **YOKE** Integral with bonnet in 2″ to 4″ sizes.
- **WEDGE** In 10″ to 24″ sizes, with Stainless Steel Wedge Rings.
- **COVER** In Check Valve.

Type 316 STAINLESS STEEL

- SPINDLE
- GLAND
- BONNET BUSHING
- SPINDLE RING
- WEDGE PIN
- WEDGE RINGS Rolled into Nickel Iron Wedge in 10″ to 24″ sizes.
- SEAT RINGS
- DISC and HANGER in Check Valve

NI-RESIST Type No. 2

- WEDGE of I-beam structure is solid NI-RESIST in 2″ to 8″ sizes.

PRESSURE RATINGS

2″ to 12″—200 lbs. O.W.G.
14″ to 24″—150 lbs. O.W.G.

This combination provides corrosion resistance well above the moderate need in many processing services with an investment well below that for all-stainless steel valves.

Designed primarily for the chemical process industries, they are recommended for control of mildly corrosive liquids with minimum quantities of mineral acids, such as creosote in wood treatment, and many liquids carried in petroleum processing.

A major use is in pulp and paper processing, particularly in lines serving the digester, and in the chemical recovery cycle. Service records in lines carrying the valve-punishing "black liquor" give Jenkins Nickel Iron Valves top performance rating.

Jenkins *extra value* construction throughout. Get details — compare. See why they stretch your valve investment dollar — with longer service life, lower maintenance cost.

ALSO RECOMMENDED for fluids used in electroplating, photograph finishing, bleaching, dyeing, and heat treating of metals.

GET COMPLETE SPECIFICATIONS from your Jenkins Valve Distributor, or write: Jenkins Bros., 100 Park Ave., New York 17. Ask for Bulletin 118.

JENKINS VALVES

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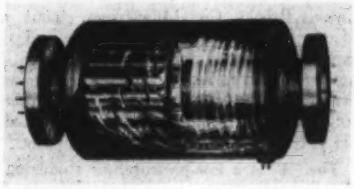
NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Available literature or information may be secured by writing direct to the manufacturer. Please mention MECHANICAL ENGINEERING

NEW EQUIPMENT



Moisture Separator

Wright-Austin Co., 3245 Wight St., Detroit 7, Mich., has announced a separator for use in horizontal steam, air, and gas lines. The device, identified as the 31-N separator, is a refinement of their 30-N type separator, the company states.

The 31 N is self-cleaning and may be used with a wide range of pressures, according to the announcement. Construction is fabricated steel. Centrifugal force is applied in the separator to remove entrainment (including water), oil, and solids from the pressure line.

Packaged Burners

A series of packaged gas burners, oil burners, and combination gas-oil burners for commercial-industrial heating and power applications has been announced by Petro, 3170 West 106th St., Cleveland 11, Ohio. In each case, the entire unit is assembled, wired, piped, and tested at the factory; components are integrally mounted on a structural steel base.

Seven stock sizes, are included in the line. Input of the gas burners range from 3,750,000 to 24,000,000 Btu; oil burners, from 25 to 145 gph. Each unit is equipped with an enclosed electrical control panel and with a forced draft fan.

Combination units and straight gas-fired units include a Petro low-pressure ring-type gas burner, automatic gas controls, air volume control, and an electronic combustion control system.

Oil burners, a Petro development of the rotary-cup type, are available for firing all grades of fuel oil. Factory-installed electric, steam, or hot-water oil heaters are available for the heavy oil models.

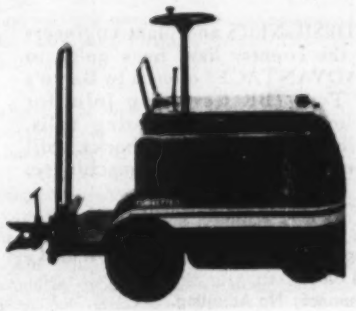
Polishing Stand

A portable polishing stand, designed to eliminate difficulties experienced when attaching and holding flat any optical polishing paper on a metal plate, has been announced by Crane Packing Co., Chicago, Ill.

With this polishing stand a 50-yd roll of 12-in. wide optical paper can be held in a recess at one end of the unit, and threaded across a steel plate or "stage." A 12 × 12-in. section of paper is held in place on the stage, and is made taut by raising the stage by two jack screws located under the base.

The stand has been primarily developed for polishing work pieces for inspection during surface grinding or lapping operation, in laboratories, or on small-run polishing jobs, according to the manufacturer.

Further particulars on this equipment may be had by contacting Crane Packing Co., Dept. MXN, 1800 Belle Plaine Ave., Chicago, Ill.

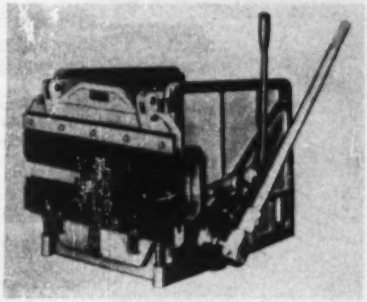


Towing Tractor

Greater driving safety, comfort, and simplicity have been incorporated in the redesigned Clarkette 5 line of general utility towing tractors, according to the manufacturer, Clark Equipment Co., Battle Creek, Mich.

Basic dimensions of this 500-lb drawbar-pull-capacity machine have been retained, the driver platform has been lengthened and the brake pedal relocated.

The Clarkette 5 control lever has been altered and the center control linkage has been moved to a lower cross bar. The exhaust pipe has been relocated at the right front side of the truck. The Continental N-62 engine has been equipped with revised piston rings and aluminum pistons. There is no increase in price for the re-designed Clarkette 5, the company states.



Hand-Operated Press Brake

A 24-in. hand-operated press brake rated at eight-ton capacity has been announced by O'Neil-Irwin Mfg. Co., 569 Eighth Ave., Lake City, Minn.

Designated Di-Acro Press Brake, this machine is said to incorporate a special cam lever mechanism which provides power for forming, blanking, piercing, drawing, and trimming operations plus a ratchet drive system that multiplies the power for heavy forming jobs.

According to the company, this new hand-operated press brake will form 16-gage mild sheet steel across the full 24-in. forming width, 10-gage mild sheet steel across a 12-in. forming width as well as Inconel, brass, aluminum, stainless steel, chrome molybdenum, and other ductile materials.

High-Voltage Oscillograph

A new d-c, wide-band high-voltage oscillograph, the Du Mont Type 329, has been developed by the Instrument Div. of Allen B. Du Mont Laboratories, Inc. The new Du Mont Type 329 provides a high accelerating voltage for use in seeing and analyzing pulses of low repetition rates or single transients. All potentials are electronically regulated in the Type 329.

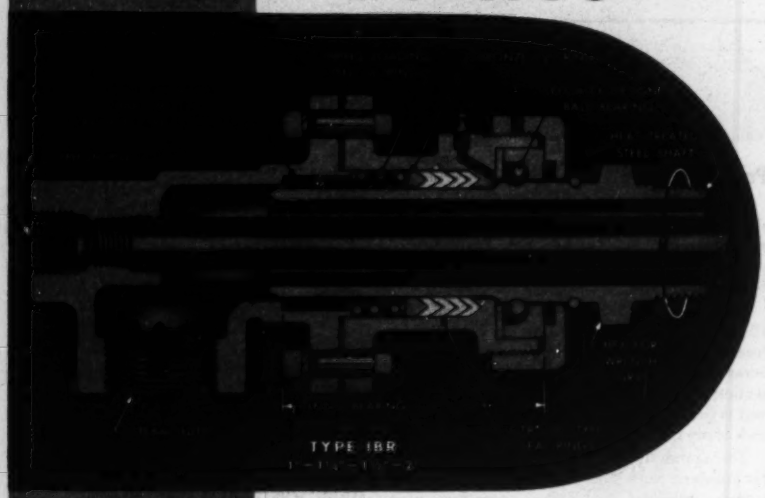
The instrument has applications in such fields as electronic computer work and color television, as well as the entire range of general laboratory applications. It is said to be of great value in color television broadcasting, where signals going out on the air must be much more carefully monitored than in monochrome video broadcasts.

The Type 329 has a direct-coupled, 10-mc (3db down) vertical amplifier and employs a 5ATP tube.

Further information is available from Allen B. Du Mont Laboratories, 750 Bloomfield Ave., Clifton, N.J.

BARCO

Revolving JOINTS



Up to 50% power savings!

PRODUCT DESIGNERS and plant engineers throughout the country have been quick to recognize the ADVANTAGES offered by Barco's new *improved* Type IBR Revolving Joint for service on drum type dryers, coating rolls, calenders, mixing drums, clutches, chucks, chill rolls, sanforizers, and other rotating machinery:

- Free-Floating, Low Torque Installations.
- Up to 50% Power Savings.
- Better Temperature Control where steam is used for heating rolls.
- Low Maintenance; No Adjusting.
- Ability to Withstand Vibration and Hard Usage.
- All Parts Easily Accessible.

Barco builds a complete line of revolving joints for steam, water, air, oil, gas, and hydraulic service. Sizes ½" to 2" and special to 5". Pressures to 250 psi, steam, or 1000 psi, hydraulic. Speeds to 2500 rpm. *Barco Engineers are at your service; ask for recommendations.* BARCO MANUFACTURING CO., 521F Hough St., Barrington, Illinois. In Canada: The Holden Co., Ltd.

Send for a copy of BULLETIN 300

WORLD-WIDE SALES and SERVICE

BARCO

THE ONLY TRULY COMPLETE LINE OF FLEXIBLE BALL, SWIVEL, SWING AND REVOLVING JOINTS

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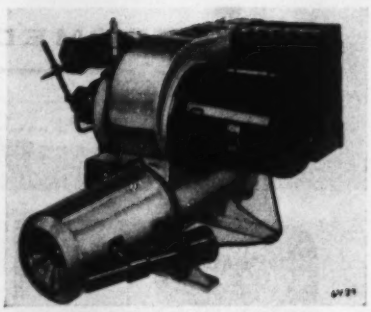
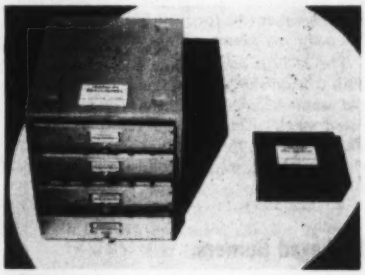


Large-Capacity Burner

The "4" Hev-E-Oil Burner, introduced by Cleaver-Brooks Co., Milwaukee, claims a 35 per cent increase in capacity, and is expressly designed for fuel users where a burner is used to heat a building containing over 1500 sq ft of radiation, or if more than 6000 gal of oil, or more than 45 tons of coal, per yr is burned according to the company.

The "4" is a low-pressure, air-atomizing-type burner, and meets the requirements of Underwriters Laboratories.

Further details will be provided by the Cleaver-Brooks Co., 326 E. Keefe Ave., Milwaukee 12, Wis.



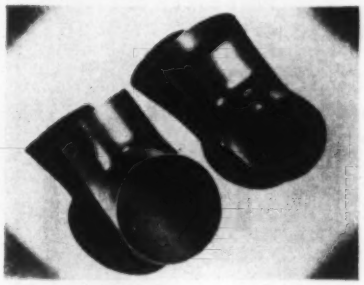
Thermistor Kits

Two kits said to enable scientists and research and design engineers to conduct exploratory studies in adapting Thermistors for temperature detection uses, and for applications in electrical and electronic circuits, have been announced by Carboloy Dept. of General Electric Co., Detroit.

Kit No. 1, the smaller of the two, includes 18 Thermistors, two of each in three styles and three sizes. The Thermistors are segregated in a compartmented drawer of the imitation leather container.

Kit No. 2 consists of a metal container with four drawers, segregating the 104 Thermistors included into 26 sizes and four styles. This larger kit also contains an assortment of steel, lead, and fiber washers as well as tubing.

Use a CLASSIFIED ADVERTISEMENT
For QUICK Results



Stainless-Steel Tubing

A high-strength, thin-wall stainless-steel tubing has been announced by Flexonics Corp. for industrial uses where corrosion resistance, light weight, and special shapes or bends may be required.

In addition, the company states it will engineer special applications of the tubing in combination with fittings and its own flexible tubing or expansion joints.

This special engineering service will be performed at Flexonics' Elgin, Ill., plant, under direction of D. Wendell Fentress, vice president in charge of research and development. Sales manager will be William C. Gage at the Maywood, Ill., headquarters office.

Flexonics makes both "standard" and "high-strength" stainless-steel straight-wall tubing. The latter claims greater yield and tensile strength for the same wall thickness through a work-hardening process. Substantial weight and material savings are said to be effected by the high strength over the standard.

Flexon standard straight-wall tube is available in fifteen outside diameters ranging from 1 in. to 6 in. The high-strength comes in thirteen outside diameters, from 1.50 in. to 6 in. All but the smaller sizes are available in four wall thicknesses. The 1.50-in. size in high strength, and the 1-in and 1.25-in. sizes in the standard are made in three different wall thicknesses.

Further information and price quotations will be sent by Flexonics Corp., 1305 S. Third Ave., Maywood, Ill.

Integrating Instruments

Two new integrating instruments, one current-integrating and the other current-squared integrating, have been announced by the General Electric Co.'s Meter and Instrument Dept.

Designed to reduce statistical analysis to a slide rule calculation, the instruments are designed for the solution of quality control problems encountered by the manufacturers of yarn, wire, strip metals, photo film, rope, plastics, and similar products in continuous moving processes, according to G-E engineers.

Developed for use with the Pacific Evenness tester, a device used in the quality control of textile fibers, the integrating instruments are said to permit the rapid determination of the average thickness and standard deviation of tested samples. They differ from conventional indicating instruments in that they contain no control springs, and have a special mechanism that provides damping.

The current integrating instrument has a permanent-magnet moving-coil driving mechanism. The speed of its pointer at any instant is proportional to the current going through the coil at that instant. Rated from minus 85 to plus 85 milliamp-sec, the instrument claims an accuracy of ±2 per cent of full scale for integrating random-varying currents lasting over a period of two minutes. The device responds to instantaneous current values as low as 0.03 milliamp and to peaks as high as 6 milliamp.

The current-squared integrating instrument has a dynamometer-type driving mech anism. The speed of its pointer at any instant is proportional to the square of the current passing through it at that instant. This instrument claims an accuracy rating of ±3 per cent for integrating ordinary random-varying signals lasting over a period of two minutes. It responds to instantaneous current values ranging from 1.5 to 30 milliamp.

Grinder Idler

The "61" Universal Backstand Idler, an attachment for all types of wall, bench, and floor, coated-abrasive backstand grinding and polishing operations, has been announced by the Coated Products Div. of The Carborundum Co., Niagara Falls, N.Y.

Designed for heavy-duty production grinding, as well as for intermittent light polishing jobs which call for frequent setup changes, the backstand idler permits belts of the same length to be employed with contact wheels of various diameters. Carborundum says varying widths of belts can be used, ranging from 1/2 to 8 in.

The "61" Universal Backstand Idler is available in two models—Model 432 for floorstand operations, and Model 431, a smaller unit, for floor, wall, or bench installation. Price includes front tracking and tension controls. Each model is available as an individual unit or as part of a packaged backstand installation which comes complete with Carborundum's T61 contact wheel.

Pipe-Thread Compound

A thread-sealing compound, which claims remarkable properties and chemical resistance, has been put into production by the Flexrock Co. The material is designated "Flexrock 25, Teflon Pipe Dope."

It is recommended by the manufacturer for use on chrome, chrome plate, nickel, steel, ceramic, and plastic pipe threads and for joining or connecting dissimilar materials. Presently it is furnished in 4-oz cans, at $5, for test purposes. Further information may be had from Flexrock Co., Packing Div., 3600-C Filbert St., Philadelphia 1, Pa.

CUT BAR STOCK up to 5/8" Diameter

Accurately, Instantly with a DI-ACRO* ROD PARTER

The shearing-breaking action of a Di-Acro Rod Parter allows most bar stock to be cut without burr and distortion. After parting, the bar is easily inserted into a hole its same diameter and the end can be threaded or riveted without further processing.

Holes in cutting heads accommodate eleven different round stock sizes. Also special heads for cutting square, and other shaped bars.

BOTH HAND AND POWER MODELS AVAILABLE

Instantaneous cutting action with Di-Acro Power Rod Parter. Rate of production is limited only by speed with which stock can be fed. Motor driven flywheel, other moving parts housed in welded, steel cabinet.

*pronounced Die-ack-ro

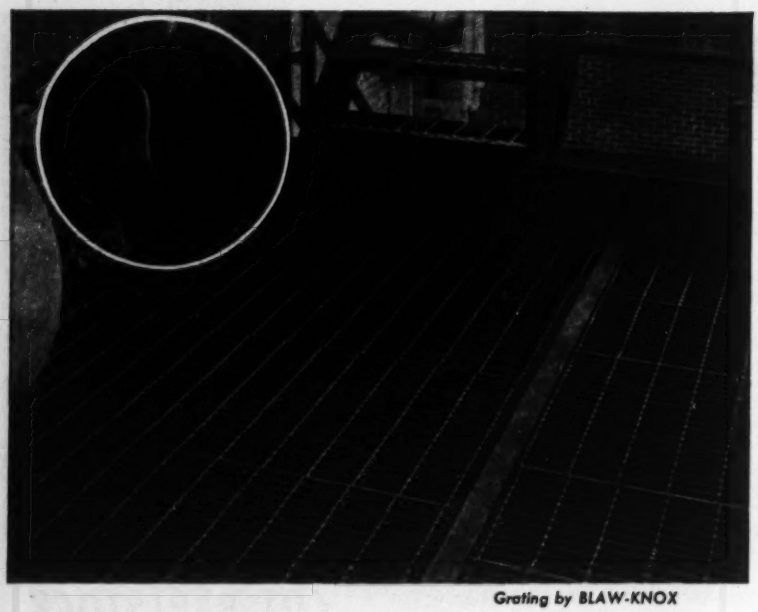
Like More Information? . . . Send for 32-Page Catalog

Gives complete details on hand and power operated Di-Acro Rod Parters, Benders, Brakes, Notchers, Punch Presses, Rollers and Shears.

Creators of "DIE-LESS DUPLICATING"

O'NEIL-IRWIN MFG. COMPANY
308 Eighth Ave.
LAKE CITY, MINN.

di-acro PRECISION METALWORKING MACHINES



Grating by BLAW-KNOX

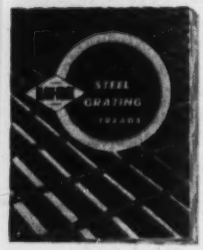
where can you use steel grating?

You undoubtedly use a lot of steel grating in your plant—floors, platforms, walkways, catwalks and stair treads, for example.

But how about grating for fan guards and shelving—for covering open pits and light wells? And how about other uses throughout your plant that no one has thought of—as steel grating is adaptable to many uses.

If you have any problem about a common application or an unusual application or a possible application, we'll be glad to hear from you. And to give you a prompt answer.

Only Blaw-Knox Electroforged® Steel Grating and Stair Treads —have these five exclusive features:



1. rigid one-piece construction—easy to install

2. all surfaces accessible—easy to paint

3. no sharp corners to dog—self-cleaning

4. maximum open area—for light and ventilation

5. non-slip twisted crossbar—safe footing

A short note will bring you a copy of new Bulletin No. 2365-R —a dimensional sketch will bring you a quotation.

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BLAW-KNOX COMPANY
2105 Farmers Bank Building • Pittsburgh 22, Pennsylvania

BLAW-KNOX EQUIPMENT DIVISION
GRATING DEPARTMENT

GRATING APPLICATIONS: floors • platforms • walkways • catwalks • stair treads • fan guards • shelving • and many other uses, both outdoors and indoors, for versatile steel grating.

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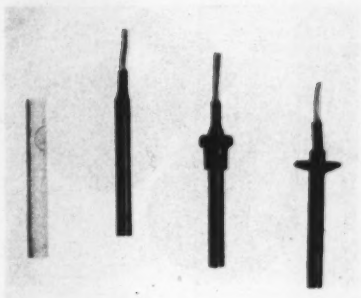


Midget Thermostats

A series of precision midget thermostats has been developed by Fenwal Inc., Ashland, Mass. These heat controls, called the midget Thermoswitch, are $^1/_4$ in. in diameter and approximately $2^3/_8$ in. long.

Because of its size and double-lead design, the midget thermostat may be used, with suitable relay circuit, as a temperature controller in any heated device, such as a platen, where installation space is limited. It may also be used as an overheat detector in high-rpm machine bearings, ovens, oil pumps, and heater ducts.

The thermostat is said to be unusually stable under shock and continuous vibration. Under continued 10G vibrations exerted along each of three mutually perpendicular planes, the unit will maintain its preset actuation temperature to approximately 5 deg F, according to the manufacturer.

The midget Thermoswitch unit is factory set to actuate at any selected temperature in range of −65 to +450 F. Depending on the set point, the unit will have an accuracy of 1 to 5 deg F. It is designed for 1 amp service at 115 v a-c or 32 v d-c.

Three different models comprise the line of midget thermostats. One model has a triangular mounting flange; the second has a threaded hexagonal head for mounting in a tapped hole; the third model has a stud locator to facilitate mounting in a slotted hole.

Reservoir Filters

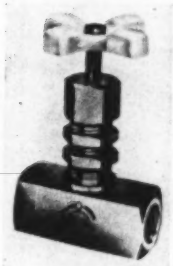
The Skinner Purefiers Div. of Bendix Aviation Corp. has announced the Bendix-Skinner Reservoir Filter, using the Bendix-Skinner ribbon filter element. The Bendix-Skinner ribbon filter element is a helically wound cellulose ribbon impregnated with phenolic resin. Removal of particles down to 40μ (about 0.0015 in.) is claimed.

Five sizes are available, ranging from $3^1/_2$-in. diam and $6^3/_4$-in. over-all length to $5^1/_2$-in. diam and $12^3/_4$-in. over-all length. Bulletin 675 contains an illustration of and information on the reservoir filter, including flow-rate pressure-drop characteristics curves for various fluids for each of the sizes, and is available on request from Skinner Purefiers Div., Bendix Aviation Corp., 1500 Trombly Ave., Detroit 11, Mich.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Panel-Mounted Needle Valve



The PM Series, a panel-mounted needle valve, has been developed by the Jas. P. Marsh Corp. of Skokie, Ill.

All PM Series needle valves are machined from extra heavy bar-stock steel and are designed for a maximum working pressure of 10,000 psi for use on water, oil, or gas. The valve stem is of 416 stainless steel, machined with fine-pitch threads. A packing called "Marpak" is used to produce a leaktight seal around the valve stem.

Valve bodies are marked in accordance with MSS regulations showing size, material, service symbol, and maximum pressure.

Air-Conditioning Pump

Ingersoll-Rand Co. has announced an air-conditioning centrifugal pump known as the ¾ KRVSA Motorpump. It is a single-stage, 3450-rpm unit with a keyed, cap-screw-type impeller attachment. The bronze, die-cast, balanced impeller has a built-in shaft sleeve. Standard jet-pump motors ½ to 1 hp are used, and the pump is said to deliver capacities to 48 gpm at heads to 100 ft. A mechanical seal consisting of a rotating ceramic face against a stationary Teeplelite face is claimed to prevent stuffing-box drips and eliminate motor overloads. This new Motorpump is specifically designed and constructed for air-conditioning and refrigeration service, I-R says.

Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y., or any of its branch offices will send bulletin No. 7126-D on request.

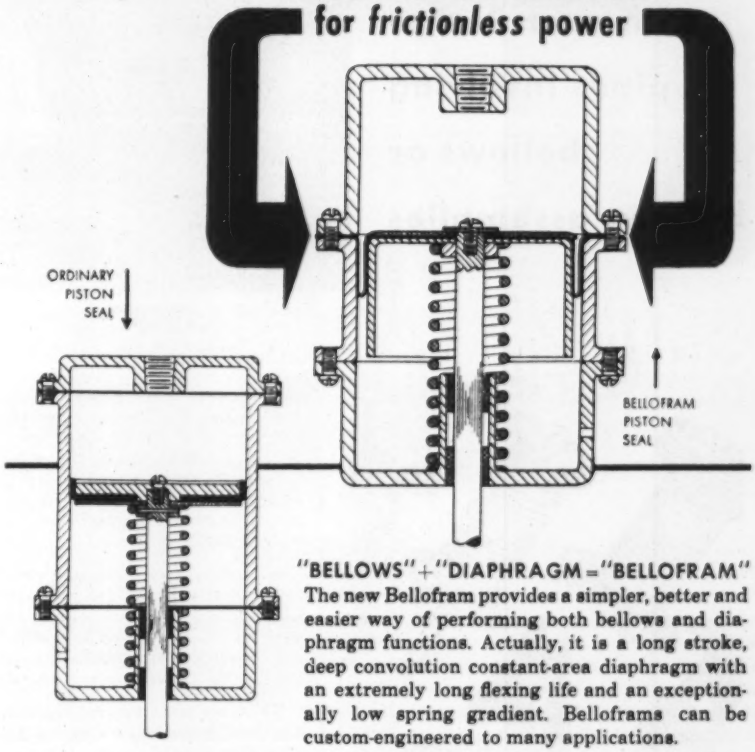
Radio Level-Indicator

Accidental overfilling or emptying of bins, silos, tanks, and other storage units can now be prevented automatically, it is claimed, by an electronic signal device developed by Hewitt-Robins Inc., Stamford, Conn. The instrument, called the Robintronic Level Indicator, uses a radio signal to indicate and control the level of stored material. The Robintronic consists of a small radio transmitter housed in a steel probe which is placed at the level where the flow of material is to be controlled. When the stored material rises and envelopes the probe, or drops and exposes it, the change in surrounding density distorts the signal being broadcast to the remote control unit. This change then either sets off an alarm or actuates the mechanism which regulates the flow of material.

Multiple installations of the Robintronic provide not only control at the danger points of overfilling and emptying, but can present a picture of the actual level of partially filled storage units, the company says.

NEW

Bellofram*
PISTON SEAL
for *frictionless* power



"BELLOWS" + "DIAPHRAGM = "BELLOFRAM"

The new Bellofram provides a simpler, better and easier way of performing both bellows and diaphragm functions. Actually, it is a long stroke, deep convolution constant-area diaphragm with an extremely long flexing life and an exceptionally low spring gradient. Belloframs can be custom-engineered to many applications.

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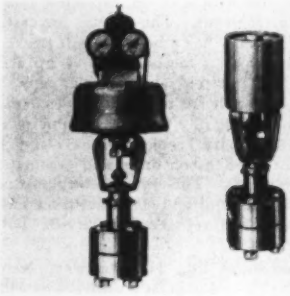
Stroboscopic Light

A compact, portable Strob-Light, designed for checking speeds of rotating equipment and calibrating tachometric devices, has been announced by the George L. Nankervis Co., Detroit, Mich. Operating on the stroboscopic principle, it checks speeds at sixteen intervals between 450 and 3600 rpm and at ten additional intervals up to 6000 rpm.

The Model H operates on any 115-v 60 cycle a-c circuit. A technical bulletin is available upon request.



High-Pressure Valves

The newest addition to the line of high-pressure control valves manufactured by The Annin Co., Los Angeles, Calif., is the series 34 line of valves for pressures to 6000 psi and temperatures to 900 F. Pictured are models 3460, Domotor operated, and 3420, cylinder operated.

Also available is model 34, manually operated. Valves are furnished in sizes $\frac{1}{2}$ in. and $\frac{3}{4}$ in. in a selection of body and trim materials, in both offset globe and angle bodies. Further information will be provided by The Annin Co., 6570 E. Telegraph Rd., Los Angeles 22, Calif.

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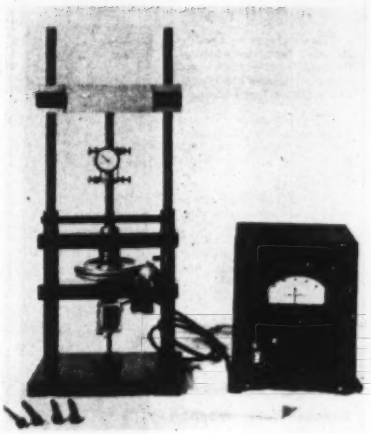


Portable Comparator for Extensometers

For calibrating extensometers, compressometers, dial gages, and similar instruments (primarily those defined in ASTM Specification E83-52T as Class B instruments), Baldwin-Lima-Hamilton Corp., Philadelphia 42, Pa., has announced an extensometer comparator.

The new Baldwin instrument uses a Microformer (miniature variable transformer) and null balance indicator to apply small displacements to extensometers with an accuracy claimed within 10 millionths of an inch for calibration. The instrument weighs 44 lb as compared with 1200 lb for a National Bureau of Standards comparator of similar type.

Extensometers having gage lengths up to 10 in. and ranges up to 0.250 in. can be checked by means of this comparator. Standard equipment includes adapters for extensometers used on 0.252-in., 0.357-in. and 0.505-in. diameter rounds. Other adapters are available. A bulletin, No. 4210, will be sent on request.

General-Purpose Cathode-Ray Oscillograph

A wide-band cathode-ray oscillograph, featuring precision measurement of both time and amplitude over the range of general laboratory applications, has been announced by the Instrument Div. of Allen B. Du Mont Laboratories, Inc. The new instrument is called the Du Mont Type 323.

The direct coupled, 10 mc (3db down) vertical amplifier of the Type 323 enables display not only of very-low-frequency phenomena, but also of high-speed pulses, together with their d-c level, Du Mont says.

A 12-page bulletin describing the Du Mont Type 323 has been published by Du Mont. It is available upon request from the Technical Sales Dept., Allen B. Du Mont Laboratories, Inc., 760 Bloomfield Ave., Clifton, N.J.

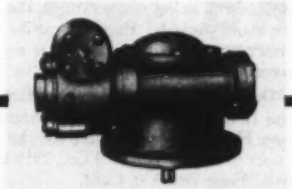
To whip toothpaste into a smooth, lump-free consistency *Abbé Dispersall Mixers use...*

Squeezed with ease from tube to brush, most toothpaste made today owes its smooth, lump-free consistency to Abbé Dispersal Mixers, according to Abbé Engineering Co., New York City.

Within each Abbé unit, two pairs of heavy paddles move through the paste in an intricate pattern with violent turbulence to break up agglomerations of solids and liquid globules. Directly coupled to the motor powering the paddles is a Winsmith Speed Reducer, Worm Gear Model 6 BDV, with an input of 1½ (or 2) hp at 1750 rpm and a reduction ratio of 81¼ : 1. *Correct stirring speed for thorough mixing is assured!*

Compactness of this Winsmith model, which features a flanged vertical design, proves especially advantageous to Abbé in meeting requirements for cover mounting within low headroom limits.

More than likely, you, too, will find a versatile Winsmith unit to best meet *your* requirements. With fully standardized differential, worm gear, helical gear and worm helical designs available, the Winsmith line is the most complete within its range of 1/100 to 85 hp and 1.1:1 to 50,000:1 reduction ratios. Request catalog 148 for details.



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Catalytic Device for Diesel Exhaust

A catalytic muffler that reduces the noxious and irritating components of 4-cycle diesel engine exhausts has been developed by Oxy-Catalyst, Inc., Wayne, Pa. The new device, called the Dieseler, attaches directly to the engine exhaust manifold and burns by catalytic action the noxious carbon monoxide and odorous hydrocarbon fumes in exhaust gases.

In announcing that the Dieseler is now in production, Oxy-Catalyst said that the first model has been operating successfully for over three months in the limestone mine of the Coplay Cement Mfg. Co. The new catalytic exhaust has permitted the Coplay, Pa., cement manufacturer to operate a standard diesel-powered tractor-shovel underground without danger from exhaust fumes, according to the manufacturer.

Thermostatic Control for Cooling Water

Provision for thermostatic control of cooling water is supplied on a new model, Size B Ignitron, WL-5551-A, available from the Westinghouse Electric Corp.

The WL-5551-A is a sealed, stainless-steel-jacketed, water-cooled, mercury-pool tube. It is capable of replacing the standard model WL-5551 directly, with the advantage of provision for thermostatic control. A calibrated thermostat, attached to the mount provided on the side of the tube, may be used to stop tube operation in case of insufficient water flow, or may be used with a solenoid water valve to turn cooling water on and off as needed.

The tube is designed primarily for resistance welding control. Two tubes normally used with single-phase welders will control 600 kva at 250 to 600 v over a 25- to 60-cycle frequency range.

Further information will be supplied by Westinghouse Electronic Tube Div., Dept. T-061, Box 284, Elmira, N.Y.

10-12-In. Plug Valves

Two new balanced-type plug valves, the Hamer 10-in. and Hamer 12-in., have been announced by Hamer Oil Tool Co., Long Beach, Calif.

Currently being produced in ASA 150-lb and 300-lb classes, the plug valves are available in carbon steel and other materials. Chain wheel attachments for overhead operation are available on both models. Intended for refinery and general service involving high as well as low temperatures, these valves are gland packed. Packings can be changed under pressure while the line is on stream, according to the company.

Descriptive literature on the Hamer 10-in. and 12-in. plug valves may be obtained from any Hamer representative or by writing direct to Hamer Oil Tool Co., 2919 Gardenia Ave., Long Beach 6, Calif.

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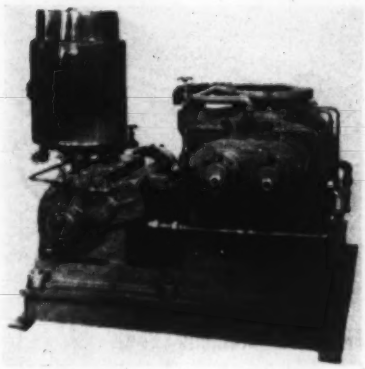

Mechanical Booster Vacuum-Pump

The Kinney Mfg. Div. of the New York Air Brake Co., Boston, Mass., has introduced a mechanical booster vacuum pump for use as a high-vacuum stage in the low-pressure range where single-stage vacuum-pumps have poor volumetric efficiency. Designated Model MB, the pump is a rotary positive-displacement pump equipped with mechanical shaft seals.

The first in a series of Kinney MB Pumps is now in production. This Model MB 1200 is combined with a Kinney single-stage 125-cu-ft pump, and the unit is capable of producing a blank-off pressure of 0.1μ (10^{-4} mm) McLeod gage. At 1μ pressure the pumping speed is about 750 cfm, and in the pressure range from 10μ to 1 mm Hg the pumping speed is about 1000 cfm. At high vacuum the combined unit requires about 5 hp, and at an inlet pressure of 15 mm Hg, about 15 hp.

The unit is arranged for automatic control. The MB 1200 pump, provided with built-in bypass valve, is directly connected to a 10-hp, 1800-rpm motor. The single-stage 125-cfm backing pump is provided with a 5-hp, 520-rpm gear motor, both units being assembled on a common base plate as shown.

Combination Bucket-Flight Conveyor Fills and Empties Silos

Unusual feature of the coal handling system at the new dyestuffs plant of Ciba States, Ltd., Toms River, N.J., is a 276-ft "round-about" conveyor which both fills and empties powerhouse coal silos.

Built by the Gifford-Wood Co., Hudson, N.Y., the conveyor travels up, over, down and under three silos of 330-ton capacity each. It acts as a bucket conveyor when ascending and as a flight conveyor when traveling horizontally. Incoming coal is picked up by the ascending section and discharged during horizontal travel across the silo tops.

Silos empty onto the "round-about" as it travels beneath them. Coal is carried up and across the silos and delivered to a flight conveyor which feeds 60-ton-capacity bins supplying coal to boiler furnaces. Thus, one conveyor handles all coal going into or out of the silos.

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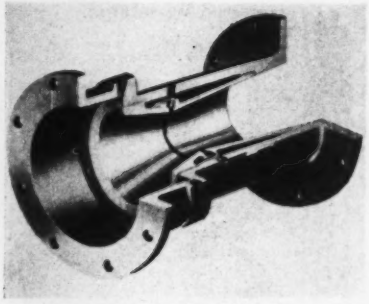

Fluid Measurement Tube

Builders-Providence, Inc., Div. of B-I-F Industries, Inc., Providence, R.I., has announced a device known as the Dall Flow Tube for metering liquids and gases.

The Dall Flow Tube is designed for use with gases and liquids carrying no settleable solids. It consists of a flanged, cylindrical body designed with an abrupt decrease in diameter, followed by a conical restriction and diverging outlet.

Features claimed for the Dall Flow Tube include: lowest permanent head loss of any known differential producer of the velocity-increaser type, short length and low weight for easy installation, Meehanite Iron body, corrosion-resistant bronze liner, minimum maintenance provided by unobstructed flow path, accuracy assured by precision-machined bronze throat liner, and low cost resulting from compact design.

Capacity tables and head loss data may be obtained from Builders-Providence, Inc., 345 Harris Ave., Providence 1, R. I.

Pressure Filter

A new type of pressure filter for dewatering granular materials has been announced by Hydro-Blast Corp. Material is fed into the machine in slurry form, and is discharged at less than 10 per cent moisture content by weight, the company states.

Operation is automatic, by means of electric timers. Shop air at 85 psi is employed for dewatering, Hydro-Blast says, claiming that average air consumption is 15 cfm and that power is required only for solenoid valves and timer.

Information is available from Hydro-Blast Corp., 2550 N. Western Ave., Chicago, Ill.

GIVE ENOUGH + SOON ENOUGH

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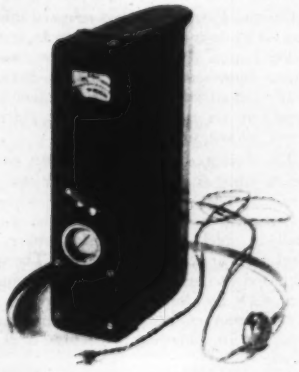

Lightweight Radiation Detector

A new Norelco lightweight radiation detector, PW 4010, that fits a man's pocket, is available from the Research & Control Instruments Div., North American Philips Co., Inc., 750 South Fulton Ave., Mount Vernon, N.Y.

The unit is 1.7 in. thick, 4.1 in. wide, 6.6 in. high, weighs about 25 oz, and is designed for locating sources of beta and gamma radiation. It can be used for measuring radiation exposure of laboratory workers and for checking intensity levels during research investigations.

It can be employed in studies of radioactive contamination and in work with radioactive sources and tracers. It can also be used for x-ray monitoring, geological surveys, locating lost radio-active materials, and for guiding persons in contaminated areas. The new radiation detector has a 1.5-v pen-light-type filament battery, two 30-v miniature-type anode batteries and a 15-v sub-miniature-type grid bias battery.

The unit employs a halogen-quenched counter tube, type 18502, that operates at 350 v, and a diode-pentode oscillator tube, type 95106. Main switch has six positions: off; start; low sensitivity; high sensitivity; anode voltage; filament voltage. Calibration switch has four positions: anode battery off; anode voltage 60 v; anode voltage 55 v; anode voltage 47.5 v.

Four-Way Valve

Airmatic Valve, Inc., 7317 Associate Ave., Cleveland 9, Ohio, announces a new hand-and-foot-operated four-way valve with patented built-in, full-capacity, flow-control meters of the Venturi type. It is an air and low-pressure hydraulic valve, specifically designed for the control of double-acting air or hydraulic cylinders.

The basic valve is also available for remote pilot operation, cam, and single or double solenoid together with time-delay features. The valve is available in four standard pipe sizes, 1/4 in., 3/8 in., 1/2 in., and 3/4 in. for air, oil, or water, in the pressure range 0–150 psi.

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Destructive effects of extremely high temperature can be minimized—by using Kentanium at the critical points.

WHAT is Kentanium?

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WHERE is it in use?

Successful applications include: Valves, valve seats, reduction crucibles, anvils for spot welding, hot extrusion die inserts, bushings, thermocouple protection tubes, flame tubes, furnace tong tips, balls for hot hardness testing, nozzle vanes and blades for jet engines, and many others.

WHAT forms are made?

Tubes, rods, bars, flats by extrusion process. More complex parts by machining from pressed slugs before sintering, extremely accurate parts by grinding to required tolerance after furnace sintering.

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Power Plug and Receptacle

Cannon Electric Co. has released information on a power plug and receptacle, numbers 20295-1 and 20296, for use on tractors, trucks, busses, stationary engines, on oil field, heavy industrial marine, or ordnance equipment, or on other portable or stationary prime power sources.

The fittings carry two 200-amp contacts for number 0 cable with 110-v to 440-v service. The cable entry is watertight sealed with a screw-tightened clamp. The shell is steel and synthetic rubber. The steel parts are cadmium plated. The spring-actuated snapcovers protect both plug and receptacle by closing when not in use. The silver-plated copper-alloy contacts may be removed for soldering, inspection, or replacement.

Special Bulletin PR-GB1 is available on request from the factory catalog department, Cannon Electric Co., 3209 Humboldt St., Los Angeles 31, Calif.

Bronze Electrode

A Bronzochrom electrode, EutecTrode 1850, has been developed for high-strength joining and for frictional and corrosion resistance on a variety of base metals by the Eutectic Welding Alloys Corp., Flushing, N.Y.

The electrode produces copper-base deposits alloyed with silicon, manganese and chromium, etc. Hardness as deposited is 130–140 Bhn and this can be increased by cold working to 230–240 Bhn, according to the company.

The electrode is recommended by the manufacturer for joining and overlaying steel, cast iron, and copper alloys. It is claimed excellent for combinations of ferrous and nonferrous metals, including stainless steel, nickel, and nickel alloys.

Further information can be had from Eutectic Welding Alloys Corp., 40-40 172 St., Flushing 58, N.Y., asking for leaflet TIS 2190.

VOLUNTEERS NEEDED

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NEW EQUIPMENT
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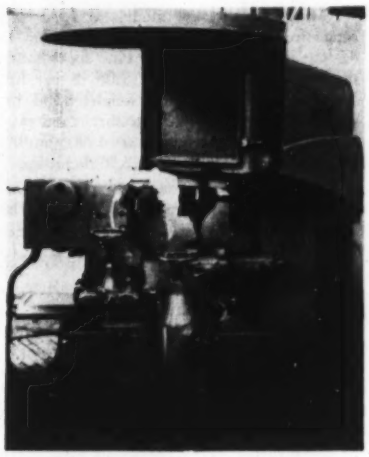
Dust Removal System

A liquid precipitating stack gas scrubber has been developed for installation in low-cost housings of cinder block, concrete, or fabricated steel by the Johnson-March Corp., Philadelphia, Pa.

The housings for this system can be built by the user as a permanent installation or, if made of fabricated steel, as a portable unit. All connections are made to existing ducts. Neither cloth bags nor filters are used.

The scrubber is said to remove large volumes of dust from the stack of cyclones, rotary dryers, kilns, roasters, mixers, pulverizers, sintering plants, asphalt plants, chemical plants, and similar industrial installations.

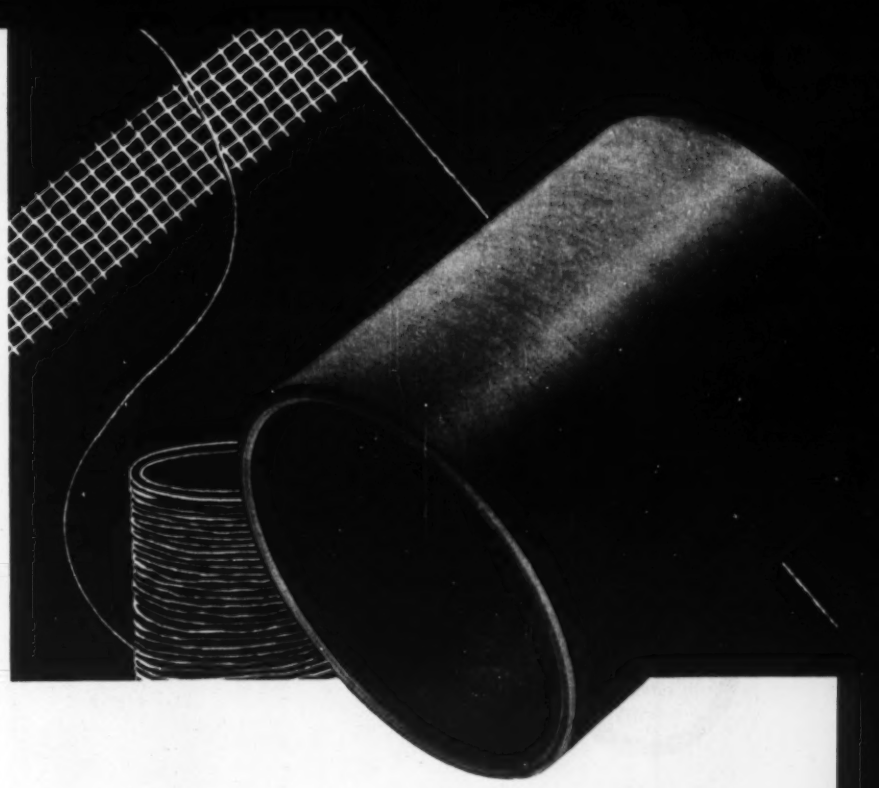
Eight models are available that can handle high-temperature gases in capacities ranging from 8000 cfm to 60,000 cfm. These range in size from the smallest, 19 ft long, 9 ft high, 5 ft 4 in. wide, to the largest, 28 ft long, 17 ft high, 13 ft 4 in. wide. Approximately $2^1/_2$ gal of water per minute at 40 to 50 psi are required per 1000 cfm.



Optical Profile Grinder

The first of a newly designed Optical Profile Grinder, manufactured by Ludw. Loewe & Co. A.G., Berlin, Germany, has arrived in this country. The machine has been installed at the New England Carbide Tool Co.

The Loewe Optical Profile Grinder is said to be suited for the precision form grinding of complex flat form tools, circular form tools, sectional dies, gages, templates, cams, and punches. A 20 × 20-in. Shadograph screen permits the operator to follow with the grinding wheel slides a line drawing. Grinding wheel, work piece, and the line drawing are visible at all times. Maximum working area is $2^3/_8 \times 10$ in. through longitudinal and cross-wise displacement of working table. All Loewe machines are distributed in this country by Eric R. Bachmann Co., 27-11 41st Ave., Long Island City 1, N.Y.



Here's how micarta® LAMINATED PLASTICS is boosting textile production

Textile processors needed a sizing bobbin which would resist the crushing pressures encountered in pre-setting synthetic yarns. MICARTA in this case stood up where other materials failed. This success is typical of the way MICARTA is helping in all phases of the textile process.

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Perhaps you've been searching for a material that won't warp or change dimension under unusual stress. Or, you may need a smooth- and slow-wearing part which will end the plague of snagging and costly abrasion. No matter where the trouble area is, there's a good possibility that MICARTA can be of help. What MICARTA has done for other manufacturers, it can do for you. Investigate the amazing qualities of this proven industrial plastic. Write for the complete MICARTA story today.

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Applications of cathode-ray oscillography

DISPLACEMENT vs. PRESSURE

The Physical Setup: A pressure-relief (poppet) valve fed by high-pressure air or gas.

The Problem: To determine motion of the valve in relieving excessive pressure and to record pressure during valve operation. Maximum linear valve motion is only 0.040".

The Solution: A resistive pressure transducer is attached to a fitting on the pressure line to the valve. The transducer is one branch of an electrical bridge circuit balanced for 1500 psi, the pressure at which the valve operates. Pressures different from 1500 psi cause a resistance change, unbalancing the bridge, and a voltage proportional to pressure *difference* appears in the center arm of the bridge. This voltage is amplified by an a-c amplifier, chopped to provide a static reference pressure of 1500 psi and applied to one channel of a dual-beam cathode-ray oscillograph*.

To measure valve displacement, a differential-transformer armature is attached to the valve shaft. Signal from an audio oscillator is applied to the transformer. Valve motion displaces the armature and a signal appears at the transformer secondary directly proportional to valve displacement. This signal, applied to the second channel of the oscillograph, triggers the sweep when the valve is opened.

Static measurements were used to calibrate the oscillograph. The oscillogram, recorded by an oscillograph record camera**, shows that the pressure drops rapidly from 1500 psi (A) to 900 psi (B) in about 0.027 seconds when

the valve "pops" to relieve pressure. The valve begins to close linearly from its maximum travel of 0.040 inches (C) until it is 0.0135 inches (D) from closed where it suddenly "pops" closed and is inoperative until the pressure again reaches 1500 psi. During valve closure, pressure builds up slowly from 900 psi (B) to 1130 psi (E) where the valve "pops" closed and then more rapidly approaches the static 1500 psi line along a logarithmic path determined by damping of the line and valve at the pressure source.

An important application of Du Mont cathode-ray instrumentation by Walter Kidde & Company, Belleville, New Jersey.

DU MONT *for Oscillography*

*Du Mont Type 322
**Du Mont Type 297

For further information concerning the Du Mont instruments used in this application, contact:

ALLEN B. DU MONT LABORATORIES, INC.

Technical Sales Department • 760 Bloomfield Avenue, Clifton, New Jersey

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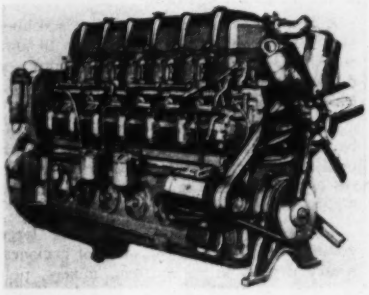

Two-Cycle Diesel Engines

P&H Diesel Engine Div., Harnischfeger Corp., has announced production of an improved line of 2-cycle diesel engines claiming 36 per cent greater power output. While of the same basic design as the former models, the new engines carry 52 major advancements and refinements, according to the company. Operating speed is 1800 rpm. Compression ratio of all models is 16 to 1 and bore and stroke are 4.5 in. × 5.5 in.

Ratings for the new models at 1800 rpm range from 58 to 255 hp. Displacement is 87 cu in. per cylinder. The six-cylinder model weighs 1800 lb, for 7.06 lb per hp. The four-cylinder model weighs 1500 lb, with 8.33 lb per hp. For the three- and two-cylinder engines the figures are 1190 and 975 lb total weight, 9.30 lb and 12.50 lb per hp.

Complete information and specifications on the new line are available by writing the P&H Diesel Engine Div., Harnischfeger Corp., Crystal Lake, Ill.

Industrial Hose Couplings

The Parker Appliance Co., Cleveland, Ohio, has expanded its line of reusable type Hoze-lok fittings to include 13 additional sizes of the industrial hose couplings.

Along with Parker's previously established line of industrial hydraulic and mobile equipment hose fittings, the new additions conform to SAE Hose Fitting Standards and applicable specifications of JIC Hydraulic Standards.

The Parker line of hose fittings for low-, medium-, and high-pressure installations include swivel nut fittings, male pipe thread fittings, flare nose fittings, and the component sockets, swivel nut nipples, male pipe thread nipples, and flare nose nipples. Swivel nut and flare nose fittings mate with Triple-lok tube fittings providing a wide range of adapters. Hoze-lok fittings are made for SAE type 100R1 rubber-covered single-wire-braid hose, for SAE type 100R2 rubber-covered double-wire-braid hose, and for SAE type 100R5 cotton-covered single-wire-braid hose.

More information is available from the Tube and Hose Fittings Div., The Parker Appliance Co., 17325 Euclid Ave., Cleveland 12, Ohio.

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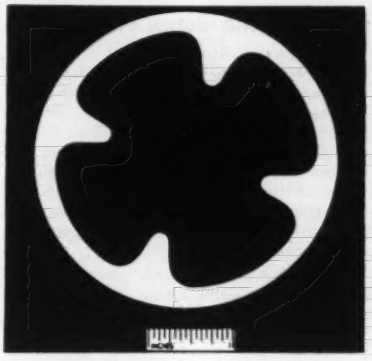


Internal-Fin Tubing

One of the new types of products made possible by extrusion is tubing with integral fins on the inside surface. Such tubing has been produced by the Tubular Products Div. of the Babcock & Wilcox Co.

The fins on the inside or outside of tubing increase the surface area, permitting a greater transfer of heat in a tube of a given length and diameter. Tubing with ID fins, shown in the illustration, was produced by B&W of a special heat-resisting stainless steel. It is used in a heat exchanger with fire on the outside and gas on the inside.

Similar tubing can be produced of a number of steels in a limited size range. Additional information pertaining to special tubular shapes produced by extrusion is available upon request to the division's general sales offices at Beaver Falls, Pa.

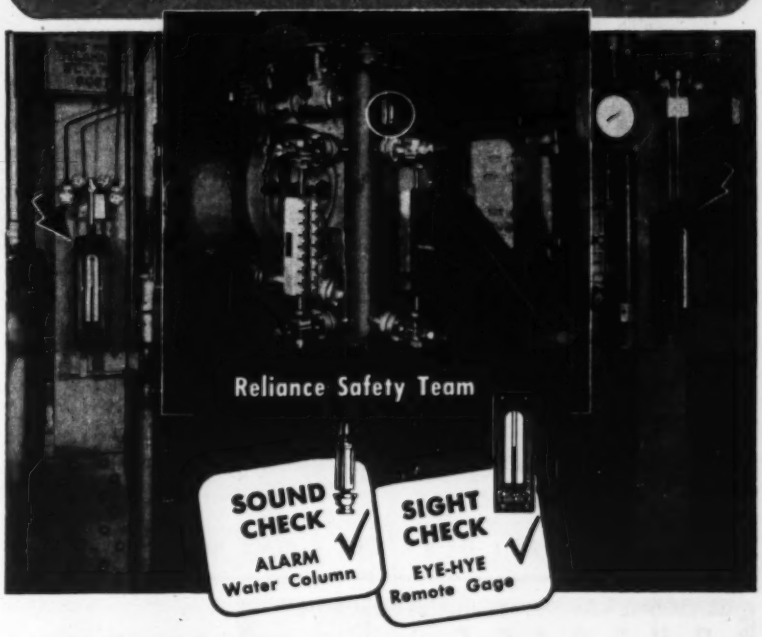
Horizontal Gear Shaver

A Red Ring Model GCJ-36 horizontal gear shaving machine that will finish teeth on spur and helical gears up to 36-in. pitch diameter having shafts up to 142-in. long has been announced by National Broach & Machine Co., 5600 St. Jean Ave., Detroit 13, Mich.

The machine is equipped with a power-driven headstock and a center tailstock, each mounted on base extensions and traversed by rack and pinions for positioning. Gears up to 2 diametral pitch having face widths up to 36 in. can be finished on the new shaver, according to the manufacturer. Crowning of tooth surfaces on spur and helical gears up to 12 in. wide having shafts up to 62 in. long are also said to be performed on the machine.

A 5-hp motor drives the headstock through a worm gear drive and change gears. The power crossfeed for the cutter slide is provided by a 3-hp motor driving through reduction gearing, change gears, and a lead screw and nut arrangement. Two speeds are provided by this drive; one for traverse and one for feed. A $\frac{1}{4}$-hp motor drives an integral coolant pump in the machine. A guard rides on rails at the front of the machine. The machine is 213 in. long, 113 in. deep, and 75 in. high over-all. It weighs approximately 42,000 lbs.

You can have Double Safety through Double Supervision of your boiler water levels



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Depending on one source of water level checking is short-sighted these days. Make *doubly sure* with the Reliance Safety Team. The Alarm Water Column with sensitive float-operated mechanism faithfully warns with a whistle blast if level reaches unsafe low or high positions. But operators rarely let that happen when they have constant access to the accurate EYE-HYE Remote Gage reading, located conveniently at eye-level on panel or wall.

EYE-HYE's green indicating fluid is now more evenly illuminated by a fluorescent lamp. And EYE-HYE can be equipped to control lamps or horns in still other plant locations. Make your boiler extra safe like the many in steam plants everywhere enjoying Safety Team water level supervision. Write the factory or your nearest Reliance representative.

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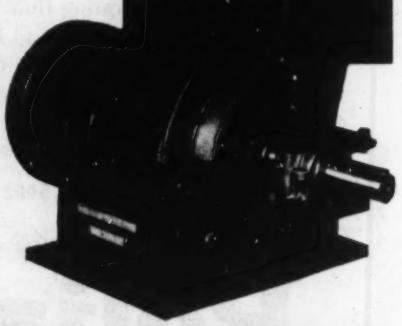
Designed for capacities beyond those of lab mills and below those required for large-scale crushing operations. Effectively used for wide range of materials. Up-Running Models (for maximum fines), Down-Running (for minimum fines). Equipped with rings or any of a full variety of hammers. Backed by over 40 years' experience in building reduction equipment. Write for Catalog on "13" Series Crushers.



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Packaged Boiler-Burner Unit

The Kewanee-Ross Corp. has announced the Kewanee-Petro Boiler-Burner Unit, for high- and low-pressure steam and hot water heating. The Kewanee-Petro Boiler-Burner Unit is available in 13 sizes from 39 to 456 hp at 120 and 150 psi water pressure, and for low-pressure use with 15 psi steam or 30 psi water in sizes to generate 1,313,000 to 15,300,000 Btu per hr. The units may be fired with No. 6 or lighter fuel oils, gas, or combination of both.

Catalog 502, 16 pages, describes the Kewanee-Petro units, listing advantages. A double-page cutaway illustration points out numerous features of construction and operation. Ratings, dimensions, and other data are included in tabular form. Copies may be obtained from Kewanee-Ross or Petro representatives, or from Kewanee-Ross Corp., Kewanee, Ill.

Welding Electrodes

The Lincoln Electric Co. has announced the second electrode in its line of electrodes with powdered metal in their coatings. Called Jetweld 2, the new electrode is designed for welding butt and deep groove joints. It is a companion electrode to Jetweld 1, designed for welding horizontal and flat fillet joints.

These electrodes with powdered metal in their coatings are claimed to weld at the lowest possible cost per foot of weld with excellent x-ray qualities, easy slag removal, top physical properties, smooth appearance and low crack sensitivity.

The electrode can be used on steels with hardening tendency, according to Lincoln. Typical values said to be: yield, 55,000 psi; tensile, 66,000 psi; elongation as welded, 28 per cent; stress relieved, over 30 per cent; Charpy keyhole notch impact values average 37 ft-lb at room temperature, and the transition temperature is below −100 F. The electrode is classified at E-6020 and meets all E-60 classifications in the downhand position. It is available in $^{5}/_{32}$-in., $^{3}/_{16}$-in., $^{7}/_{32}$-in. and $^{1}/_{4}$-in. diameters.

Hot and Cold Testing Chamber

A testing chamber which automatically cycles test parts through alternate hot and cold temperatures has been announced by Cincinnati Sub-Zero Products Co. The unit, which has a test chamber 30 in. long, 11 in. wide, and 16 in. deep, produces first a low temperature, down to −120 F. It then raises the temperature to 200 F and will repeat the cycle as many as 100 times. Holding time at high and low levels is variable with a dual-set timer which determines half-cycle time anywhere between 0 and 120 minutes.

Other equipment on the unit includes a 24-hr chart recording thermometer, and a 2-in. porthole. Further detail on this unit may be obtained by writing direct to the manufacturer, Cincinnati Sub-Zero Products Co., 3932 Reading Rd., Cincinnati 29, Ohio.

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Sheet Blasting Machine

Pangborn Corp., Hagerstown, Md., has announced its ES-503 Rotoblast machine for cleaning steel sheet and plate up to 54 in. in width at a production rate of 20 to 80 lineal ft per min. The ES-503 is claimed capable of cleaning in excess of 200 sq ft of surface per min. It is equipped with two Rotoblast wheels which throw 160,000 lb of abrasive per hour.

This machine has been designed to take the steel sheet or plate into the blast chamber automatically, blast its surface, and remove all abrasive from the sheet before it is discharged from the machine. The abrasive cleaning operation is accomplished by means of a blow-off fan which deposits the abrasive in a spiral conveyor. It is moved to the elevator which carries it up through the abrasive separator and reclaimer for recycling. Standard equipment for the ES-503 is two 195-5 RG wheels (wide vane), each powered by a 50-hp, 1800-rpm motor. The machine can also be ordered with smaller Rotoblast wheels, where production requirements are lower.

Overall dimensions of the machine are approximately 22 ft high, 18 ft wide, and 15 ft long. Further information about the ES-503 may be obtained from Pangborn Corp., Hagerstown, Md.

Portable Temperature Test Chamber

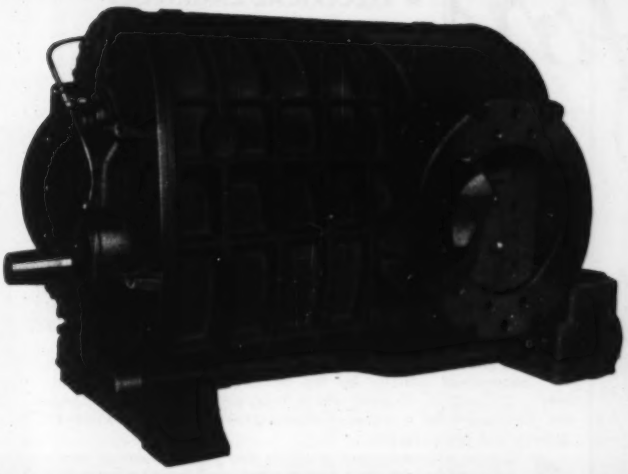
The improved TC-2 Temperature Test Chamber is available from stock from Statham Development Corp., 12411 W. Olympic Blvd., Los Angeles 64, Calif., superseding the Model TC-1 chamber. The range has been extended 75 deg F, permitting tests from −65 F to 350 F. A Weston industrial thermometer is mounted on the front panel. A loading port at the top of the chamber permits the addition of dry ice.

The chamber is recommended by the company for ambient temperature variation tests of small products such as basic instruments, electronic sub-assemblies, components, paints, foods, dyes, textiles, organic materials, plastics, rubber, and hydraulic or pneumatic accessories.

The working space is 7 in. high, 15 in. wide, and $7\frac{1}{2}$ in. deep. The test load is carried in a removable tray provided with fifteen $\frac{3}{8}$-in.-diam openings for connections to the objects under test. Air is circulated continuously in a closed path past the test load. Heat is absorbed from the circulating air by the evaporation of dry ice, and heat is added through a thermostatically controlled electrical resistance heater. Designed to operate from 115 v, single-phase, 5 amp, 50–60 cycles, the Model TC-2 Temperature Test Chamber may be plugged into any standard electrical outlet. The overall dimensions are 48 in. long, $16\frac{1}{2}$ in. high, and 12 in. deep.

A descriptive bulletin is available upon request.

Standardaire® Blower



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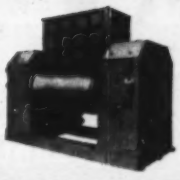

Read Standard also manufactures a complete line of chemical mixers for industrial and laboratory uses.

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Sandia engineers and scientists design and develop complex components and systems that must function properly under environmental conditions that are much more severe than those specified for industrial purposes. They design and develop electronic equipment to collect and analyze test data; they build instruments to measure weapons effects. As part of their work, they are engaged in liaison with the best production and design agencies in the country, and consult with many of the best minds in all fields of science.

Sandia Laboratory, operated by Sandia Corporation under contract with the Atomic Energy Commission, is located in Albuquerque — a modern, mile-high city of 150,000 in the heart of the healthful Southwest. Albuquerque offers a unique combination of metropolitan facilities plus scenic, historic and recreational attractions; and a climate that is sunny, mild, and dry the year around. New residents have little difficulty in obtaining adequate housing.

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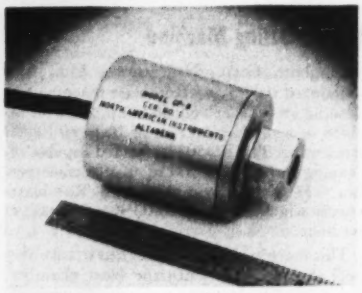

High-Range Pressure Transducer

The Model GP-8 High-Range Pressure Transducer has been added to the Northam line of variable-reluctance-type transducers manufactured by North American Instruments, Inc. Available ranges extend from 200 to 5000 psi gage and all are rated at 100 per cent safe overload. The instrument is claimed suitable for both static and dynamic measurements. The natural frequency runs from 2000 cps at the lowest range to 10,000 cps at the highest.

The Model GP-8 has been designed with particular emphasis on resistance to mechanical vibration and shock excitation. The acceleration response in the most sensitive axis is less than 1 per cent full scale per 1000 g in all ranges above 1000 psi. Applications are suggested in rocket and jet engine testing where the close mechanical coupling required for high frequency response introduces mechanical excitation. Other applications include laboratory measurement and industrial control using indicating, recording, and control systems adapted to operation with variable-reluctance-type transducers.

The electrical pick-off elements are plotted with epoxy resin in plugs which are screwed into the body. All metal surfaces are finished with electrolyzed chrome for resistance to corrosion and wear. The weight is 12 oz.

The electrical characteristics of the Model GP-8 are the same as those of other Northam transducers. Any excitation frequency from 60–50,000 cps may be used, the maximum input voltage at 3000 cps being 30 v. The full scale output is 40 mv per v input in bridge circuit operation. The rated accuracy including linearity is 1 per cent full scale or better. Inquiries should be directed to Mr. Eugene Bollay, Vice President, North American Instruments, Inc., 2420 N. Lake Ave., Altadena, Calif.

Additional Opportunities for positions are offered among the display advertisements on pages 58, 60, 64, 71 and 123

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Steam Cleaning Material

Oakite Products, Inc., has announced the development of a cleaning material, Oakite Composition No. 93, specifically designed for use in steam-generating equipment and in steam guns where the solution is siphoned from an auxiliary tank. The material, the manufacturers report, has been approved by the US General Services Administration, appearing on the qualified products list as meeting Federal Specification—Steam Cleaner—P-S-00751 (G.S.A.-F.S.S.).

Oakite Composition No. 93, the manufacturer states, is a white free-flowing powdered material which is soluble in water in a range of concentrations and use. Normal working concentrations range between 1/4 and 4 oz per gal of water, into which the material is sprinkled and stirred until dissolved. Solutions of Oakite Composition No. 93 are claimed non-toxic and it is said that no offensive odors or unpleasant fumes are given off.

Additional information will be sent to those addressing Oakite Products, Inc., 142A Rector St., New York 6, N.Y.

Pneumatic Control Drive

The Bailey Meter Co. has announced a pneumatically operated control drive, for butterfly valves, dampers, feeders, etc., which the company says may now be operated on a straight-line flow characteristic. A pneumatic signal actuates a positioning relay which in turn positions a piston-operated drive lever arm. Three different characteristic cams are supplied and may be shaped if necessary.

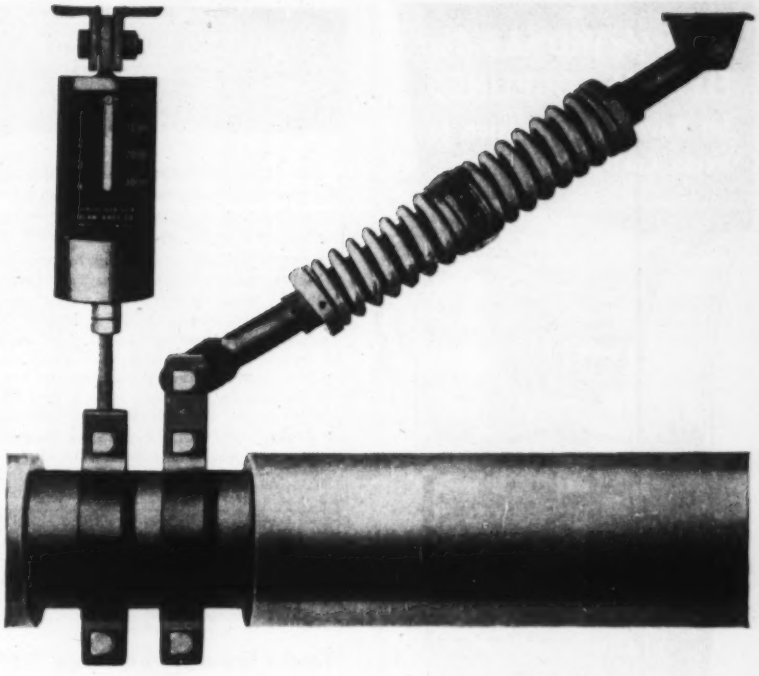
The drive is 10 in. × 11 in. × 19 in., and may be installed in any position on a column, pipe, or flat surface, according to Bailey. Time required for the full travel of 75-deg is adjustable. The drive has a 4-in. piston stroke at a torque of 75 ft-lb. It operates on standard SAMA signal ranges 3-15 and 3-27 psig. Standard connecting linkage is available from stock.

The Bailey Control Drive is manufactured by Bailey Meter Co. 1026 Ivanhoe Road, Cleveland 10, Ohio. It is available from stock at $210.00 f.o.b. Cleveland, complete with enclosure, positioning relay, and hand operator. Product Specifications CA040 and CA942-B provide more information.

High-Velocity Steam and Air Exhaust Silencers

A line of high-velocity steam and air exhaust silencers has been announced by the Burgess-Manning Co.

The line is known as Series ADS Acoustic Discharge Silencers. They are designed to eliminate high- and low-frequency noises caused by high-velocity discharge from steam and air devices. The silencers operate on the patented Burgess-Manning snubbing principle and employ acoustic reactance chambers with sound-absorbing material.



complete hanger units cut your field erection costs

One sure way to cut your field erection costs is to use Blaw-Knox hangers and eliminators. Each is a complete packaged unit, ready to install. No expensive cutting, threading and assembling on the job. And you'll also save on engineering and specifying time.

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Any time you'd like some help, our experienced engineers are available to both design and make recommendations for your hanger requirements. Send for your copy of Bulletin No. 54 to get full information.

BLAW-KNOX COMPANY, Power Piping and Sprinkler Division, Pittsburgh 33, Pa.

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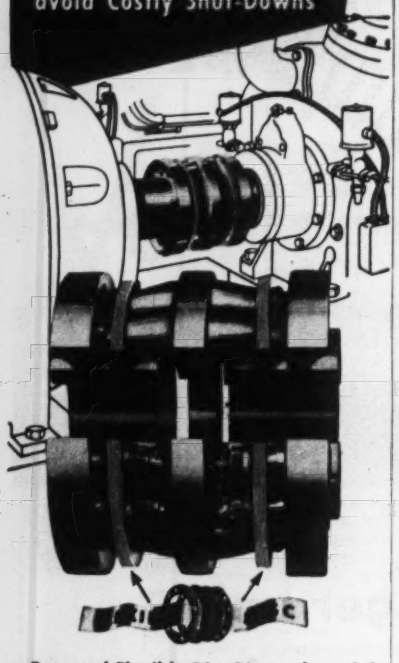
PIPE HANGERS

Complete line of functional spring hangers • rigid hanger assemblies • overhead roller assemblies • supports • vibration eliminators . . . plus complete prefabricated power piping systems for all pressures and temperatures.

Specify THOMAS ALL METAL
FLEXIBLE COUPLINGS
for Power Transmission to avoid Costly Shut-Downs



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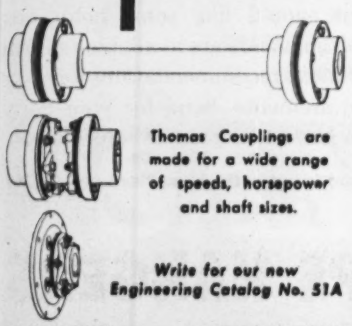
FACTS	EXPLANATION
NO MAINTENANCE	Requires No Attention. Visual Inspection While Operating.
NO LUBRICATION	No Wearing Parts. Freedom from Shut-downs.
NO BACKLASH	No Loose Parts. All Parts Solidly Bolted.
CAN NOT "CREATE" THRUST	Free End Float under Load and Misalignment. No Rubbing Action to cause Axial Movement.
PERMANENT TORSIONAL CHARACTERISTICS	Drives Like a Solid Coupling. Elastic Constant Does Not Change. Original Balance is Maintained.



Thomas Couplings are made for a wide range of speeds, horsepower and shaft sizes.

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THOMAS FLEXIBLE COUPLING CO.
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The silencers are recommended by Burgess-Manning for use on steam vents, steam safety valves, hogging jets, gas turbines, air nozzles, evacuating ejectors, and similar devices.

Series ADS will be available in three models: ADSO for optimum silencing in critical areas; ADSS for silencing required in semi-residential and light industrial areas; and ADSC for commercial silencing in noncritical areas. All models will be available in standard 8-in. to 30-in. pipe size, but special sizes are available upon request. Series ADS is described in Bulletin No. 265, which may be obtained by writing to H. A. Dietrich, Sales Manager, Burgess-Manning Co., Libertyville, Ill.

BUSINESS NOTES

Wheeler-Economy Fire-Pumps Dept.

Economy Pumps, Inc., Div. of C. H. Wheeler Mfg. Co., Philadelphia, Pa., has announced the organization of a Wheeler-Economy Fire Pumps Dept. under the direction of J. U. Engelbrink, formerly of the Chicago office of Economy Pumps, Inc. Mr. Engelbrink is now headquartered in Philadelphia, managing product development and marketing of a line of fire pumps approved by Underwriter Laboratories and Factory Mutual Fire Insurance Co.

Dravo Opens California Office

Dravo Corp., Pittsburgh, Pa., has announced the opening of a West Coast office in the Monadnock Bldg., 681 Market St., San Francisco, Calif.

The San Francisco office will handle Dravo's line of oil- and gas-fired industrial space heaters and process drying equipment, crane cab and steel-mill pulpit air-conditioning equipment, prefabricated power and process piping, open steel flooring, and Dravo construction services.

The office will also represent Walker Process Equipment, Inc., manufacturers of water, sewage, and industrial waste treating systems.

Beaumont Birch Appoints Representatives

Beaumont Birch Co., Philadelphia, Pa., manufacturers of coal, ash, and chemical bulk handling equipment, has appointed the D. J. McAllister Boiler Works, 862 N. Spauling Ave., Chicago 51, Ill., representatives for the Chicago area. Victor Ganger of the McAllister Boiler Works will be responsible for sales supervision of Beaumont Birch in the area.

Ross Irwin Equipment Co., 713 Ambassador Bldg., St. Louis has been appointed representative for Beaumont Birch in the St. Louis, Mo., area.

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EXPERIENCED ENGINEERS
—seeking wider scope for their creative abilities—find, at Jack & Heintz, unparalleled opportunities on a wide variety of *aviation and commercial projects in:*

Design • Development
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YOUNG ENGINEERS
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The editors of Mechanical Catalog are expanding and improving the directory section to make it of even greater service to you . . . of even greater value to manufacturers of products used and bought by mechanical engineers in industry.

Listing guides have been sent to 4,300 companies to enable them to conveniently check off products they wish listed in this valuable reference book. Likely your company has received one of the guides. If it has not been returned to us, you'll do your company and the Society a great favor by expediting its return. If your company has not received a free product listing guide, drop us a line and we'll forward one immediately. By all means, be sure your company's products are listed in the directory section of the 1955 MC.

MECHANICAL CATALOG

Published annually as a service for members by

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

29 West 39th Street, New York 18, N Y.

Marley Builds Louisville Plant

The Marley Co., Kansas City, Mo., has built a new plant in Louisville to manufacture more of the company's Aquatowers, which are mechanical draft cooling towers for air conditioning and refrigeration service. The new plant replaces Marley's former manufacturing facilities in Louisville.

The plant occupies ten acres and provides 77,000 sq ft of production space.

Eastman Kodak to Move to New California Laboratory

Eastman Kodak Co. announces that beginning January it started moving photo processing equipment from its San Francisco laboratory to the company's new photo processing laboratory at Palo Alto, Cal.

The Palo Alto laboratory will serve the Northern California-Oregon-Washington-Idaho-Nevada area and will deal almost exclusively in the processing of 16 and 35 millimeter color film.

Synchronous Motor Control

Synchronous motors and their operation and control are described in a two-color 16-page bulletin issued by the General Electric Co., Schenectady 5, N.Y.

Water Sampling

An informational leaflet describing some of the factors involved in obtaining useful samples required for proper control of water conditions in a power house has been released by Allis-Chalmers Mfg. Co.

The literature tells which samples are important, when samples should be taken, where to obtain them, and how they should be drawn. Copies of the leaflet, "Effective Water Sampling," 28X7969, are available upon request from Allis-Chalmers Mfg. Co., 949 S. 70th St., Milwaukee, Wis.

10,000-lb-Capacity Fork Truck

The Model F-39T10 electric-powered, 10,000-lb capacity fork truck is illustrated and described in a folder released by The Elwell-Parker Electric Co., 4205 St. Clair Ave., Cleveland 3, Ohio. The literature contains more than a dozen photographs showing the truck in a variety of applications, plus model shots and detailed views of components. Engineering drawings are also included. The folder lists design specifications, operating and construction features, and applications. A page is devoted to an analysis of major components.

Copies of the literature may be had without charge.

PPC

When You Buy

Pumps and Compressors

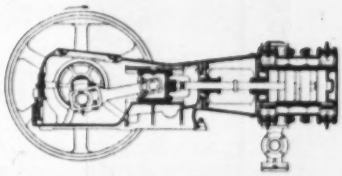
DO YOU WANT | LONG LIFE, EASY MAINTENANCE, RELIABILITY

These Are **BUILT-IN** *By* **PENNSYLVANIA**

AIRCHEK VALVE

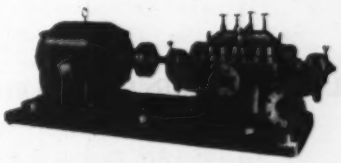
Automatically prevents reverse flow through Compressor and also dampens pipe line pulsations.

This Check Valve should be on EVERY Compressor. Bulletin 509 E



OILFREAIR & OILFREGAS Compressors Class ATL with steel-backed carbon cylinder-liners. Guaranteed to compress free of any trace of oil or oily vapors.

Bulletin 600 E



PENNSYLVANIA 4-Stage THRUSTFRE Centrifugal Pump for Boiler Feeding, General Power Plant and Industrial Use.

Bulletin 237 E

YOUR Copy of Catalog 546 briefly describes All PENNSYLVANIA Products. Write For It Today.

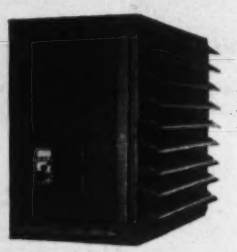
PENNSYLVANIA Pump & Compressor Co.

EASTON, PA.

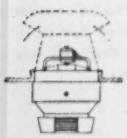
OILFREAIR® OILFREGAS® THRUSTFRE® AIRCHEK®

When air is exhausted from paint spray booths, from grinding, casting, chemical processing or other plant operations or is used in combustion, it must be replaced. Wing Fresh Air Supply Heaters provide the finest means of replacing exhausted air and supplying fresh air at the right temperature, winter and summer.

WING FRESH AIR SUPPLY HEATERS



WING FRESH AIR SUPPLY HEATER
for Window or Wall Mounting



At left is shown Fresh Air Supply Heater for mounting in roof or monitor opening.

require no extensive duct work. They are mounted in window or wall openings or below roof or monitor openings.

HOW THEY WORK. They draw in the outside air at prevailing outside temperature and pass it through multiple by-passes and heating elements which are always under full steam pressure.

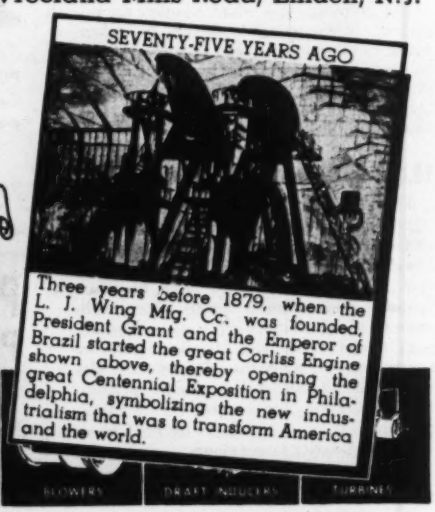
THEY CANNOT FREEZE. The heating coils can never freeze as they can where temperatures are controlled by throttling the steam supply.

UNIFORM DISCHARGE TEMPERATURES. The discharge airstream is uniform in temperature because of Wing's unique design and construction which combine several alternating by-pass and hot air passages. The multiple thin layers of hot and cold air mix almost instantly assuring uniformly warm air at the outlet.

Write for Bulletin

L. J. Wing Mfg. Co. 156 Vreeland Mills Road, Linden, N.J.

Factories
Linden, N.J. & Montreal, Canada
In Europe: Etab. Wanson,
Brussels, Belgium


SEVENTY-FIVE YEARS AGO
Three years before 1879, when the L. J. Wing Mfg. Co. was founded, President Grant and the Emperor of Brazil started the great Corliss Engine shown above, thereby opening the great Centennial Exposition in Philadelphia, symbolizing the new industrialism that was to transform America and the world.

Heat-Treating Furnaces

The R-S Furnace Corp., York, Pa., has released a catalog covering its furnace line, Bulletin No. 200, entitled "R-S Furnaces for Metal Heating and Heat Treatment." It includes descriptions and applications of the following types of heat-treating furnaces: car hearth, rotary hearth, pit, roller hearth, belt, chain, pusher and Hi-Head. The Hi-Head furnace is a unit of small cross section for continuous handling of long, straight stock, such as bars, pipes, tubing and slabs, regardless of length.

Automotive Air Cylinders

A 12-page catalog containing engineering data on five different models of automotive air cylinders and each of eight different sizes has been released by Petch Mfg. Co. Sizes range from $1^1/_2$-in. to 6-in. bore. The cylinder has been designed for heavy duty in automation, dies, die automation, conveyor, foundry, welding equipment, and automatic machinery. This information is also available on the regular line of Petch and Pemaco air and hydraulic cylinders.

The catalog will be sent on request by Petch Mfg. Co., 463 York, Detroit 2, Mich.

Two ways you can protect your family against CANCER

...a check

...a check-up

Cancer strikes in one of every two families. Each year more than 60,000 American children under the age of eighteen lose a parent to cancer.

Yet many cancers can be cured, if discovered in time.

Every man should have a complete physical examination once a year. Women over thirty-five should have a complete physical examination twice a year. Patients are being saved today who could not have been saved even a few years ago.

The American Cancer Society asks your help.

How soon we find cancer's cause and cure depends on how soon and how much help comes from people like you.

Send contribution to Cancer, c/o your local Post Office.

Cancer strikes One in Five
STRIKE BACK...
Give to Conquer Cancer!

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Power Installations

Articles describing power installations in a rayon plant, a pipe mill, an electrical substation, and other plants are carried in the Spring 1954 issue of *Powerfax*, a magazine published quarterly by the Elliott Co.

Articles generally are by the users of the equipment. Copies of the 32-page issue may be obtained from C. W. Kalbfus, Editor. Elliott Co., Jeannette, Pa.

Flexible Tubing

"Flexineering," the scientific application of flexible tubing for air, oil, steam, gases, and volatiles is explained in an eight-page illustrated data book just published by Pennsylvania Flexible Metallic Tubing Co.

Free copies of "Penflex Flexineering" may be requested on your company letterhead. Write to Penflex, 72nd St. & Powers Lane, Philadelphia 42, Pa.

Thread Taps

An illustrated 20-page catalog and price list published by Reiff & Nestor Co., Lykens, Pa., provides data regarding size, threads, flutes, and prices for standard taps as well as many special taps. Many other special taps, available for immediate delivery from R & N's large stock, are also listed.

Several examples are given of tap users' specific production problems solved by R & N engineering, with increased production realized. A free copy of this catalog and price list will be sent on request for Catalog 10, Reiff & Nestor Co., Lykens, Pa.

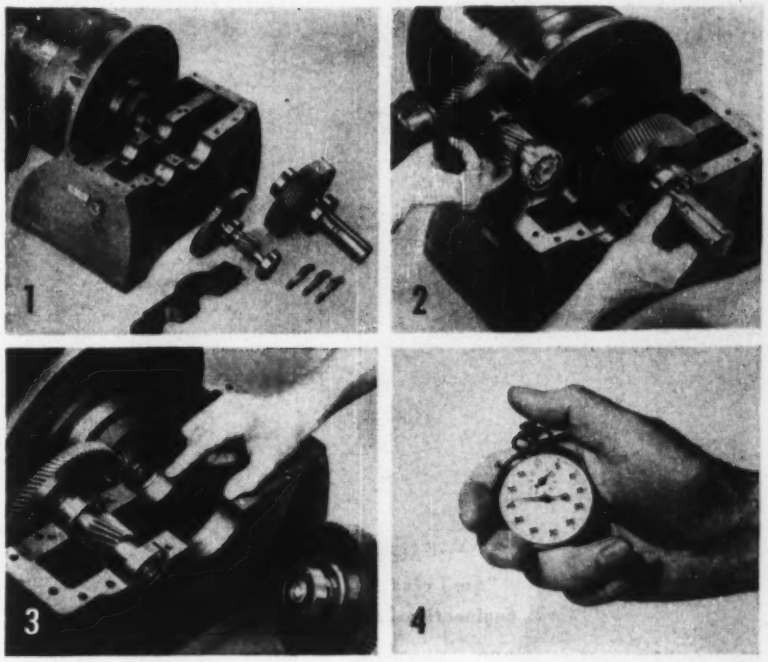
Alloy Reference Chart

A new Cooper Alloy Reference Chart listing the chemical analyses, physical properties, and recommended applications for 28 different grades of cast stainless steel has been made available by The Cooper Alloy Foundry Co., Hillside, N.J. Prepared by Norman S. Mott, chief chemist and metallurgist at Cooper, the bulletin indicates ACI, AISI, SAE, ASTM, and general "type" designations. Data on heat treatment and remarks concerning weldability and machinability are included. Copies available.

Solenoid Valves

A four-page bulletin, 500A, on solenoid valves and their applications, is available free from the J. D. Gould Co., 730 E. Washington St., Indianapolis 2, Ind. The bulletin illustrates and describes the line of solenoid valves made by Gould for automatic or remote control of steam, air, gas, or liquid flow.

Described in the bulletin are 25 types of solenoid valves, with details on their applications, operation, specifications, design, construction, and prices. The various models range in size from 1/4 to 3 in., and handle pressures up to 1200 psi (steam to 150 psi). A selection of assemblies and coils are available. Also described in the bulletin are waterproof and oilproof solenoid coils which are guaranteed for one year to withstand temperatures up to 450F.



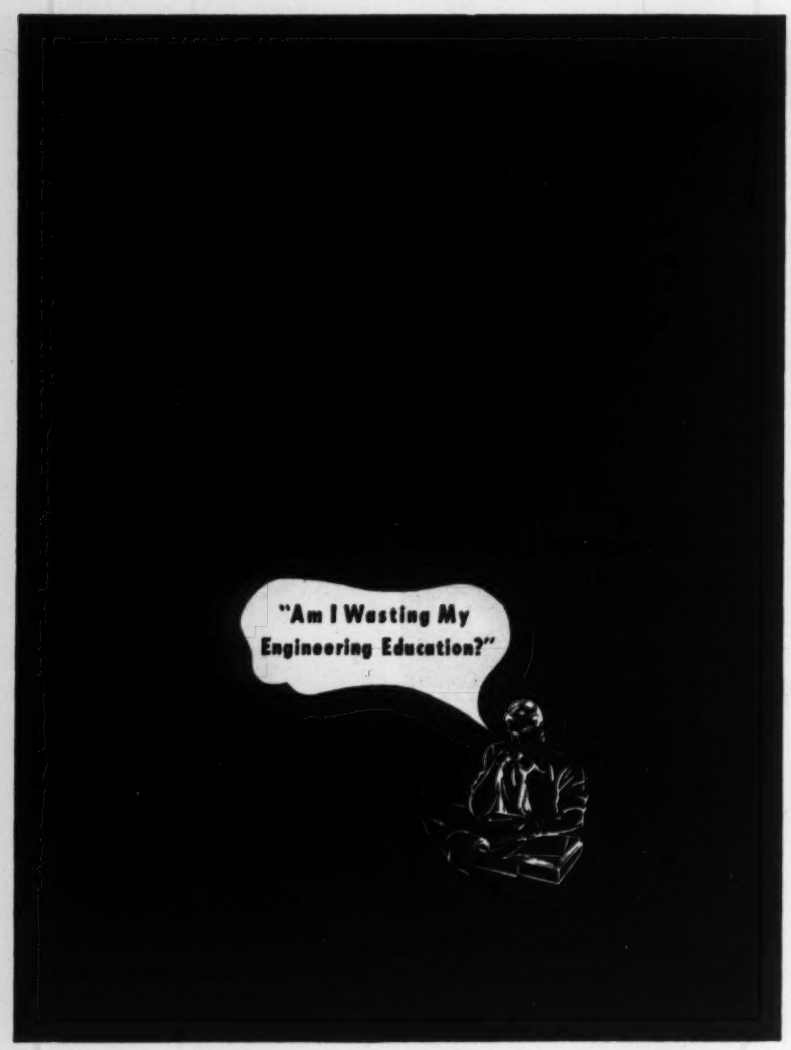
4 reasons why customers want Westinghouse Gearmotor Drive

Add sales points to your product. Westinghouse Gearmotors, with the exclusive horizontal split case, have many design advantages for you and your customers. Four such benefits are pictured above . . . here's the story behind each!

1. **Case cover quickly lifted** after removing a few bolts. No need to dismount motor, break coupling to driven load or drain oil! All servicing can be done in confined work area.
2. **No intricate subassemblies** exist in Westinghouse Gearmotors. Once case cover is removed, all gearing parts are free for removal. No further dismantling required for gearing maintenance.
3. **Firm bearing support** is assured. Bearings are anchored directly to case foundation, not in subassembly discs or spiders. Machined shoulders hold horizontal thrusts to exact tolerances . . . undue tooth wear and vibration are eliminated.
4. **4.78 minutes to dismantle** a Westinghouse Gearmotor! Each step of dismantling operation was "stop-watch timed". Included in study was time required for removal of end cap, motor, gears and pulling of pinion. Total time required . . . 4.78 minutes; a record that withstands any comparison!

Pass these advantages on to customers. Specify Westinghouse Gearmotors in your machine design. Write for free booklets—*Gearmotors* B-5645; *Speed Reducers* B-5646—to: Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-07340

YOU CAN BE SURE... IF IT'S Westinghouse



If your present work involves only a *little* engineering, there's an excellent chance you *may* be wasting those years you spent obtaining a specialist's education. Certainly you are not getting the practical training you'll need to move into a better engineering job next year — or the year after.

Here at Pratt & Whitney Aircraft our engineers work *full-time* on some of the most difficult problems facing any technical group — the development of advanced jet engines. They have a real opportunity to sharpen their skills and gain that important professional recognition.

If you, too, are interested in putting your engineering education to work, please send a complete resume to Mr. P. R. Smith, Employment Dept. ME5.

PRATT & WHITNEY AIRCRAFT
Division of United Aircraft Corporation
East Hartford 8, Connecticut

Water Storage Vessels

Every type of water storage vessel and several installations of purification and filtration plants are described and illustrated in Catalog H_2O recently issued by Hammond Iron Works. In addition to photographs of standpipes, elevated storage tanks, steel reservoirs, filtration and purification installations, Catalog H_2O includes details of designs, tables denoting sizes, capacities, etc. Copies of Catalog H_2O may be had by writing to any of the Hammond Iron Works plants which are located at Warren, Pa., Bristol, Pa., Birmingham, Ala., Provo, Utah, Casper, Wyo.

Gauge and Instrument Protector

Sprague Engineering & Sales Corp. has just issued a new bulletin on their S-214 series of automatic shut-off valves for protection of gauges and instruments in hydraulic or pneumatic systems against overloads. Several sizes are available for pressure ranges from 10 to 5000 psi. Bulletin gives features, specifications and complete adjustment and installation details. Requests for the new bulletin should be addressed to J. W. Murvin, sales manager, Sprague Engineering & Sales Corp., 1144 West 135th St., Gardena, Cal.

4-Way Valves Solenoid Controlled

The Pantex Mfg. Corp., Pawtucket, R.I., has just published a comprehensive, six-page folder describing their new $^1/_4$-in. directly operated, 4-way valves for industrial use.

Valves have an operating range from 100 to 5,000 psi and are interchangeable, mounting and port wise, with many 2000 psi valves. Sub-plates may be furnished with either side or bottom ports.

Three basic $^1/_4$-in. types are available; a single solenoid with spring offset spool, a double solenoid without spring, and a double solenoid with spring centered spool. A total of 12 assemblies may be made by varying two sub-plate types and two spool types.

Electric Cells for Level and Flow Measurement

A new, six-page Technical Information Sheet issued by The Foxboro Co. of Foxboro, Mass., describes electric d/p cell transmitters, which translate small differential pressures into electrical measurements of flow or level for instrument recording or control.

Three typical applications of the cell are stressed: measurement of oil pipeline flow transmitted up to 2000 ft with high speed of response; flow or level transmitted any desired distance by the cell and a telemetering system; and high speed laboratory measurements in such fields as jet engine testing and flow analysis.

Copies of the publication, TI 27-A-23b, will be sent on request.

Transformer Buyer's Guide

The 1954 edition of the GE Instrument Transformer Buyer's Guide, containing basic, up-to-date information on the complete General Electric line, has been announced as available from the Company at Schenectady 5, N.Y.

Pulpit Air Conditioner

Bulletin 1307, recently released by Dravo Corp., 1203 Dravo Bldg., Pittsburgh, 22 Pa., describes a pulpit air conditioner designed and developed for use in industrial control areas where heat, dirt, or fumes create hazardous working conditions.

Power Thread Gaging Units

The Taft-Peirce Mfg. Co., Woonsocket, R.I. has issued Catalog No. 612 which describes both the bench model and the flexible shaft model power thread gaging units, as well as listing the various collets and adaptors which are available.

Robot-Eye Combustion Control

New bulletin on the Type SA Robot-Eye. This unit is designed especially for the control of Rotary Cup Burners and may be used in manual, semi automatic or fully automatic combustion control systems.

Standard Instrument Corp., 350 Fifth Ave., New York 1, N.Y.

Ultrasonic Test Instruments

Branson Instruments, Inc., presents in organized form all the essential data necessary to an intelligent selection of the ultrasonic thickness-measuring instrument best suited to a particular problem or set of problems.

The tabulated data cover both models of the portable Audigage thickness testers, as well as the new automatic Vidigage with direct-reading scales on a 21" cathode-ray screen.

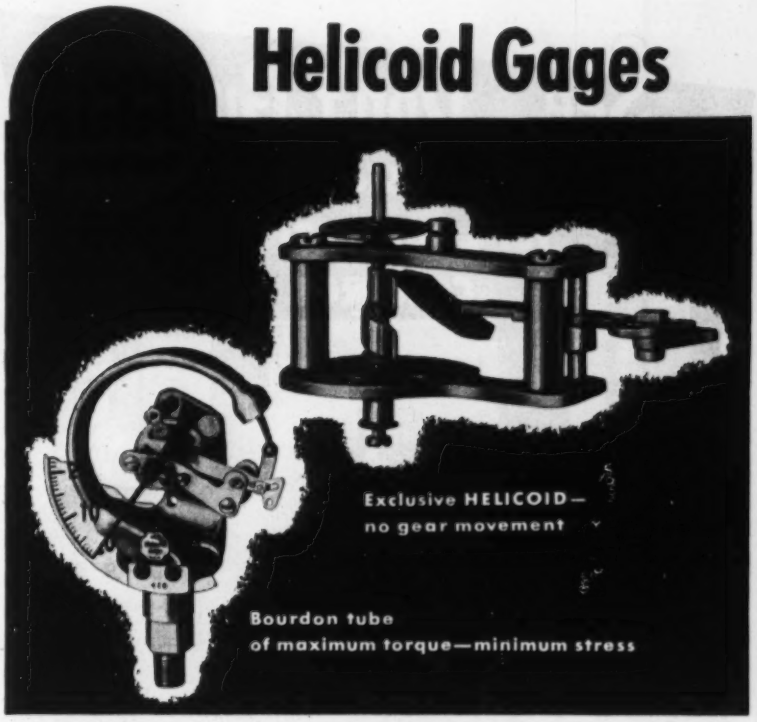
Copies of the Ultrasonic Specifications Folder are available on request from Branson Instruments, Inc., 430 Fairfield Ave., Stamford, Conn.

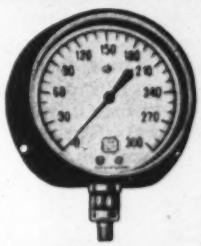
"Teflon" Technical Bulletin

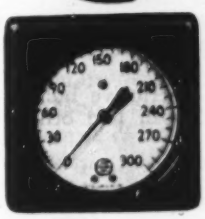
A third revision of a Du Pont technical bulletin on "Teflon" tetrafluoroethylene resin finishes is now available.

The twelve-page bulletin lists seventeen successful new "Teflon" applications in addition to those reported in the earlier edition published in March 1953. They are: agitator paddles, barrattes, dry ice platens, dye vats, filling equipment, floor tile molds, glass stop cocks, glue pots and dispensers, glueing machines, ladles, mandrels, pails, reels, rubber boot lasts, size boxes, soap dies, and troughs.

The bulletin may be obtained by writing Du Pont Finishes Div., Room D-7145, Wilmington 98, Del.







Why HELICOID Costs Less Per Gage, Per Year

HELICOID Gages have many unique and exclusive features which result in enduring accuracy and savings in maintenance cost. They cost less per gage, per year.

Only HELICOID Gages, for instance, have the Helicoid Movement . . . a simple cam and roller design which has no gear teeth to wear out. Bourdon tubes used in HELICOID Gages are carefully designed to give maximum torque and minimum stress . . . promoting the greatest possible endurance life. They withstand many millions of pressure pulsations without stretching, leaking or cracking.

There is a HELICOID long-life gage to meet every type of pressure control requirement. Pressure ranges to 20,000 psi, vacuum or compound. Dial sizes: 3½", 4½", 6", or 8½". Dials may be black, white or radiant faces. They are supplied for wall or stem mounting, flush or panel mounting, or flangeless.

All HELICOID Gages are fully guaranteed. They are time-tested and proved in years of hard service. They assure the highest degree of gage accuracy and long-life service.

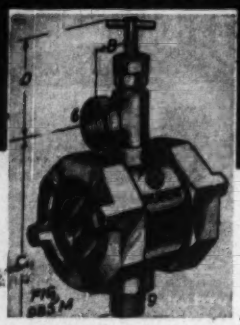
Write TODAY for the G-2 HELICOID Gage Catalog

ACCO
Helicoid Gage Division
AMERICAN CHAIN & CABLE
927 Connecticut Avenue • Bridgeport 2, Connecticut

See...Don't Guess

Install NUGENT Sight Feed Valves for LUBRICATION CONTROL

13 models designed for working pressures to 125 psi. Sizes to ¾ inch.

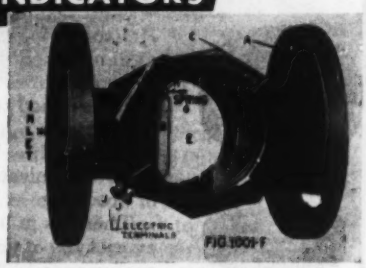


9 models for large machinery. "Swivel and lock" type for sight chamber adjustment to most convenient view position.

Medium size needle type with steel valve stem. 9 models. Sizes to ¾ inch.

WITH a Nugent Sight Feed Valve in your oil line, you can tell at a glance whether or not vital parts are receiving proper lubrication. Nothing is left to chance and there's no guess work involved. Oil flow through the valve is controllable from 2 drops per min. to 21 gals. per hour depending upon oil viscosity and valve model. All are vented to prevent air binding. Glasses and screens are removable for cleaning without interrupting oil flow.

SIGHT FLOW INDICATORS



Sight Flow Indicator available with tapped or flanged connections. Removable windows. Can be installed right or left hand or vertically.

ANOTHER NUGENT instrument for solving lubrication problems is the Sight Flow Indicator. Installed in a machinery oil system, this device sounds an alarm when oil is not getting to bearings. When oil is not flowing properly, Indicator "B" (See Fig. 1001-F closes making contact with terminals "J". This sounds the alarm making it possible to locate trouble quickly, protect valuable machinery and save on costly down time.

For trouble free lubrication systems, write for descriptive bulletin on the Nugent Sight Feed, Sight Flow Indicator and other Lubrication Specialties.

Wm. W. Nugent & Co., Inc.

409 N. Hermitage Ave. CHICAGO 22, ILLINOIS

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Water, Sewage, and Trade-Waste Treatment

Hardinge Co., Inc., York, Pa., has released a six-page brochure describing its line of water, sewage, and trade-waste treating equipment, Bulletin AH-442. Installations of Hardinge Circular Clarifiers are illustrated and the various applications of this equipment are discussed. Also included are several typical flow sheets and a brief description of auxiliary apparatus such as digesters and flocculating equipment.

Electric Motors

Electro Dynamic Div. of General Dynamics Corp. is offering Consolidated Catalog No. 100, containing information on performance, dimensions, construction advantages, and installation photographs on 1-250 hp electric motors.

Product application information is in chart form for the selection of motors for ordinary applications of polyphase squirrel-cage induction motors. A page is devoted to electrical and mechanical modifications that are available for particular installation needs. Requests should be sent to the Electro Dynamic Div., General Dynamics Corp., Bayonne, N.J.

Manual on Cemented Carbides

A new edition of the Carmet Methods Manual on cemented carbides has been issued by the Carmet Div. of Allegheny Ludlum Steel Corp. It is the seventh edition of the publication, and includes information on tool design, brazing, grinding, chip breakers, set-ups, coolants, cutting speeds, and reference data.

All grades of Carmet cemented carbides are listed, including tungsten, titanium, and tantalum carbides, along with their typical applications. Copies of the manual may be obtained by writing to Advertising Dept., Allegheny Ludlum Steel Corp., 2020 Oliver Bldg., Pittsburgh 32, Pa.

Lubrication Pumps

Trabon Engineering Corp. has published a four-page illustrated catalog on their line of Hydra-Lube Pumps and Reservoir Assemblies.

Hydra-Lube pumps are designed for automatic lubrication of hydraulically powered equipment, such as machine tools, presses, and mining machines. They connect to the supply line of any double-acting cylinder. No control valves are said to be required. Three-, five-, and 12-lb reservoir assemblies for grease or oil are available for use with the Hydra-Lube pump.

Dimensions of both the Hydra-Lube pump and reservoir assemblies are included in the catalog, as well as a diagram drawing of the method of connecting the pump to any hydraulic circuit. The catalog, A-1-54, can be obtained from Trabon Engineering Corp., 1814 East 40th St., Cleveland, Ohio.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Tubular Electric Heaters

A bulletin on tubular electric heaters for industrial services has been prepared by Turbine Equipment Co., Hynes Electric Heating Div. The bulletin illustrates and describes the component parts of the heaters including the pipe, resistors, insulators, and strap and terminal box.

The heaters have application for heating heavy oils and other viscous liquids in tanks and pipe lines, melting ice on water gates at dams, explosion-proof convection heating, etc. Also explained in the bulletin are the characteristics of electric heating, and operating comparisons with steam on these services. Copies of the bulletin can be obtained by addressing Turbine Equipment Co., Hynes Electric Heating Div., P. O. Box 578, Westfield, N.J., and asking for Bulletin 202.

Jacketed Valves

New Data Units 220 and 221 describe operational features of Jerguson jacketed valves Nos. 93 and 93U for heated-cooled gages or wherever small jacketed angle valves are required. Specifications and cutaway views showing internal construction are included. Copies are available from Jerguson Gage & Valve Co., 80 Fellsway, Somerville 45, Mass.

Cold-Rolled Steels

The Jones & Laughlin Steel Corp. has published a 16-page booklet on its Jalcase Cold-Finished Steels. Beginning with a table of analyses of the ten available grades of Jalcase, the booklet discusses machinability, distortion, heat treatments, wear resistance, mechanical properties, the J & L Electreat process, and typical uses.

Advantages claimed for the steels are: easy machinability, minimum distortion, faster heat treatment, high wear-resistance, and better mechanical properties. The booklet is available from the Jones & Laughlin Steel Corp., Pittsburgh 30, Pa.

Insulation and Refractories

"J-M Products for the Process Industries" an eight-page catalog, is issued by Johns-Manville. It gives data on the properties of the various products and includes photographs which show typical installations.

The products covered are: industrial insulations for temperatures from −400 F to 3000 F; refractories and insulating brick for furnaces, ovens, and kilns operating to 3000 F; Transite pipe for overhead and underground water lines and for process lines handling corrosive liquids and gases; Transite industrial vent pipe for venting gases, ducts, fumes, and vapors; packings and gaskets, including acid- and caustic-resisting types; Raschig rings for tower packings; and J-M Chemstone and Transite sheets for various types of fabricated equipment. Copies of "J-M Products for the Process Industries" are available from Johns-Manville, 22 East 40th St., New York 16, N.Y.

UP TO 30,000 pounds of Steam per hour from this modern TITUSVILLE package unit

TITUSVILLE

TYPE WTP
Water Tube
STEAM GENERATOR

The most steam produced in the least space—that's the measure of efficiency and simplicity of design and performance in our modern WTP Steam Generator. This water tube package unit is shop-assembled, furnished in a range of capacities from 7500 pounds of steam per hour, and is adapted for firing with all oil and gas fuels and their combinations. Write for Bulletin B-3275 on this compact steam package, today!

TITUSVILLE IRON WORKS CO TITUSVILLE, PA.

A division of Struthers Wells

THE TITUSVILLE IRON WORKS COMPANY
TITUSVILLE, PENNSYLVANIA

Manufacturers of A COMPLETE LINE OF BOILERS FOR EVERY HEATING AND POWER REQUIREMENT

how CHACE THERMOSTATIC BIMETAL INDICATES IN THE STEWART-WARNER OIL GAUGE

A Product of Stewart-Warner Corp. • Chicago 14, Illinois

Stewart-Warner's Thermo Electric Oil Pressure Gauge uses two Chace Thermostatic Bimetal elements of hairpin form to give the ultimate in accuracy for engine oil pressure indication. Using a "Double Bimetal Circuit," the oil pressure is transformed into interrupted electric currents at the S-W "sending" unit, (see drawing). When line (1) is energized and there is no oil pressure, contacts (2) are closed lightly. Resistor coil (3) heats bimetal (4) which bends to open contacts and break circuit. Bimetal then cools and the contacts close, completing a cycle of short duration. A trickle of current flows to the gauge, heating bimetal elements to move pointer to zero.

When oil pressure increases, pressure on contacts increases and opening is delayed. Current thus flows for longer periods during the cycling, more heat is generated in the gauge bimetal elements and pointer is forced to higher reading. While the current fluctuates, lag in heating and bending of bimetal arrests vibration of pointer. Actually the sending unit meters out current consistent with oil pressure and the gauge records it. Many manufacturers throughout the world who make products which are actuated by bimetal response to temperature changes, specify Chace Thermostatic Bimetal. Chace assures large and small users of a reliable source of supply of bimetal to meet a wide variety of specifications.

Write today for our new 36-page booklet, "Successful Applications of Thermostatic Bimetal," containing condensed bimetal engineering data.

W. M. CHACE CO.
Thermostatic Bimetal
1619 BEARD AVE DETROIT 9, MICH

KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

Hermetically Sealed Time-Delay Relay

The Model SF Agastat hermetically sealed time-delay relay is described in Bulletin SR5, available from the AGA Div., Elastic Stop Nut Corp. of America, 1027 Newark Ave., Elizabeth, N.J.

The Model SF Agastat measures $2^1/_8 \times 2^5/_{32} \times 3^7/_8$ in., and weighs 1.2 lb. It meets requirements of MIL-R-6106 and MIL-R-5757B for vibration, shock, acceleration, temperature resistance, and it is unaffected by voltage variations, the manufacturer states. Length of time delay is externally adjustable over a range of 0.030 to 120 sec.

The four-page bulletin includes mechanical and electrical specifications, wiring diagrams, and mounting dimensions.

Water Softener

Cochrane Corp., Philadelphia 32, Pa., has released Publication 4505-A, which describes the Zeo-Flo Sodium Zeolite Softener.

The Zeo-Flo Softener is a water softener designed for small- and medium-sized industrial plants, laundries, hospitals, apartment houses, etc. The softener has been so simplified, according to the manufacturer, that installation may be handled readily by the facilities of a small- or medium-sized plant.

Some of the many advantages claimed for the new softener are: lower cost, easy installation, minimum of piping requirements, ease of operation, and low chemical costs. Units are available in a range of sizes and capacities. Operation, design, dimensions, capacities, etc., are described. The publication is available on request.

Belt-Conveyor Electric Furnace

An eight-page booklet on belt-conveyor electric furnaces is now available from the Westinghouse Electric Corp. Belt-conveyor electric furnaces, according to the company, are designed for continuous bright hardening of carbon and alloy steel parts without oxidation or decarburization when used with an Endogas atmosphere and oil quench.

Construction features of major components are described and supplemented with illustrations. Furnace sizes including complete operating characteristics are tabulated. A schematic drawing of the belt conveyor furnace is keyed to a table of dimensions of furnaces. A drawing of the piping arrangement of the oil cooling and recirculating system for quenching is provided and approximate dimensions are listed. Illustrations of typical operating installations are provided to indicate relative sizes of major components. The booklet, D.B. 28-420, will be sent on request by Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, Pa.

For Consulting Engineers Turn to Page 134

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NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Volume Pumps

A two-color, two-page bulletin has been released by the Milton Roy Co. describing the design and operation of the HyROY-metric Controlled-Volume Pump. Bulletin 1153-A covers all the features of this pump, claimed by the manufacturer to be the largest controlled-volume pump ever built, and includes a graph showing the comparison between the new ranges of pressure (up to 50,000 psi) and capacity (up to 1350 gph) now said to be available and those formerly possible.

Copies are available free of charge by writing to Milton Roy Co., Station L, 1300 East Mermaid Lane, Philadelphia 18, Pa.

Thermistors Manual

A manual explaining what Thermistors are, how they are applied, what functions they perform, and what benefits industry derives from them in detecting and compensating temperatures and providing time delay or surge control in electrical equipment, has been announced by Carboloy Dept. of General Electric Co., Detroit, Mich.

The 52-page publication, referred to as TH-13, includes information on Thermistors, tests supplied by an independent laboratory, and characteristic curves for a Thermistor carrying current in thermal equilibrium with the ambient and for one where the time delay function is of primary interest. These curves, called static volt-ampere and dynamic-characteristic curves respectively, are provided for most of the standard Carboloy Thermistors.

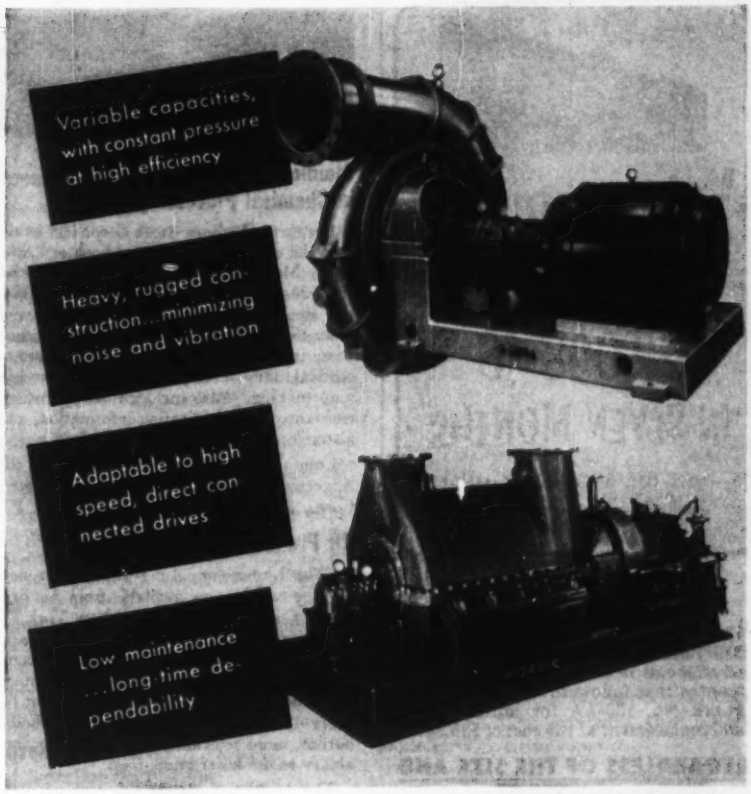
The manual provides background information, covering applications, characteristics of the Thermistor material, and explanations of the source and utility of the data as well as the curves and other general information.

Geared Turbine Generator

Geared turbine generators, 200 kw to 1500 kw, for both a-c and d-c service are the subject of Bulletin 1969 now offered by Worthington Corp. The bulletin describes engineering and construction features of the turbine generators, including two types of governing arrangements, hand and automatic nozzle controls, and other controls and accessories.

The geared turbine unit claims the following advantages over direct-connected machines for driving generators up to and including 1500-kw capacity: low initial cost; peak efficiency regardless of generator speed; low-speed exciter minimizes brush and commutator wear; either open- or enclosed-type generators may be selected depending on local conditions; relatively simple generator construction; unit can easily be arranged to operate over varying frequency ranges (50–60 cycle, 120–180 cycle, etc.).

For further information or copies of the bulletin, requests should be directed to the Advertising and Sales Promotion Dept., Worthington Corp., Harrison, N J.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Stainless Steel in Chemical Processing

Allegheny Ludlum Steel Corp. has available the second edition of its booklet "Allegheny Metal in Chemical Processing," a revised 34-page book covering the use of stainless steel in the manufacture of acids and other chemicals, in the general process industries, in the plastics industry, in pharmaceutical manufacture, in dye making, and in soap making. Also included are corrosion-resistance data, fabricating information, and a stainless steel finder.

Copies may be obtained by writing to the Advertising Dept., Allegheny Ludlum Steel Corp., 2020 Oliver Bldg., Pittsburgh 19, Pa.

Air Preheater

"The Ljungstrom Air Preheater," a new 36-page booklet now available from Air Preheater Corp., 60 E. 42nd St., New York 17, N.Y., explains the advantages of using waste heat in flue gases to preheat incoming combustion air. These advantages are claimed to be fuel savings of roughly one per cent for every 45–50 deg of preheat, increased boiler output, more economical boiler designs, and ability to use lower grade fuels.

The booklet contrasts regenerative with recuperative preheaters, and explains the operating principle, structural details, and advantages of the Ljungstrom Air Preheater, a gas-to-gas preheater of the continuous regenerative type.

Industrial applications for other than power boilers are covered, and several pages of layout drawings, showing typical Ljungstrom Air Preheater arrangements on many different types and sizes of boilers are included.

Steam Trap Bulletin

The V. D. Anderson Co., manufacturer of Super-Silvertop Steam Traps, has published a bulletin on its steam traps. The bulletin first discusses the construction of the steam trap, whose working parts are made of heat-treated stainless steel, and the valve and seat fabricated from a chrome-nickel alloy. It then follows with tables of capacities, sizes, pipe connections, pressures, weights, and list prices.

The booklet also covers Anderson Steel Series Steam Traps, which are forged for higher pressures and super-heated steam service. They are designed to withstand steam pressures up to 700 psi and 800 F total temperature, according to the manufacturer.

Technical data is given on Anderson Strainers for pressure-regulating valves and metering devices, liquid, and gas lines; steam traps and air tools; spray heads and oil burners; solvent stills and temperature regulating valves; and pumps. For each of these products, buying information is presented, including prices. Copies of the four-page Bulletin 154 will be sent on request by Steam Specialties Div., The V. D. Anderson Co., 1935 West 96th St., Cleveland 2, Ohio.

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FOR ALL GRADES OF LIQUID FUEL

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Remote Liquid-Level Indicators

Yarway Bulletin WG-182, a new 20-page catalog on remote liquid-level indicators, has been issued by the Yarnall-Waring Co., Philadelphia 18, Pa.

The catalog contains a description of the Yarway Remote Liquid-Level Indicator. In addition, application and installation information recommendations and wiring diagrams are presented. Copies of this bulletin may be had from the Yarnall-Waring Co.

Water-Tube Boilers

Wickes Type A water-tube boilers are described in Bulletin 53-1, offered by the Wickes Boiler Co. Type A boilers are built in capacities up to 250,000 lb of steam per hr and pressures up to 1000 psi. Coal, oil or gas, stoker, pulverized coal, hand, or special firing can be used.

Six different installations are illustrated by two views each. The advantages of the Type A boiler are listed. The bulletin may be obtained by writing the Wickes Boiler Co., Div. of Wickes Corp., Saginaw, Mich.

Valves and Refrigeration Equipment

The A-P Controls Corp. has announced the publication of a six-page bulletin on their Model 73 Solenoid Valve. The bulletin furnishes information concerning construction details, dimensions on four types of valves, and pertinent product features. Solenoid valve applications are outlined with schematic sketches to illustrate standard installation.

A Condensed Air Conditioning-Refrigeration Catalog has been released by the A-P Controls Corp. The catalog furnishes information on the A-P line of valves, filters, and driers for the air-conditioning and refrigeration industry. A-P product specifications, charts, how-to-select information, and sales data are provided.

Copies of the above two publications can be obtained from A-P Controls Corp., 2450 N. 32nd St., Milwaukee, Wis.

Welding Supplies

Catalog No. 495, published by Weldit, Inc., 990 Oakman Blvd., Detroit 6, Mich., covers Weldit welding equipment, accessories, and supplies. Included are complete welding and cutting outfits, welding torches, heating torches, welding and cutting tips, lightweight torches, machine cutting torches, blowpipes, the Weldit Gasaver, regulators, connections, goggles and helmets, atmospheric air and gas torches, paint burners, liquefied-petroleum-gas torches, plumbers' furnace, and accessories.

Two small leaflets are also offered by Weldit. One covers the Heaterama portable space heater, said to be the only salamander with directional heat flow, and the second covers Weldit lpg torches, furnaces, and equipment. All three publications are available on request.

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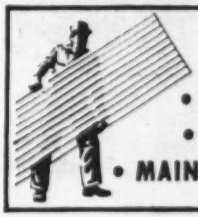

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BIDDLE *Instrument News*

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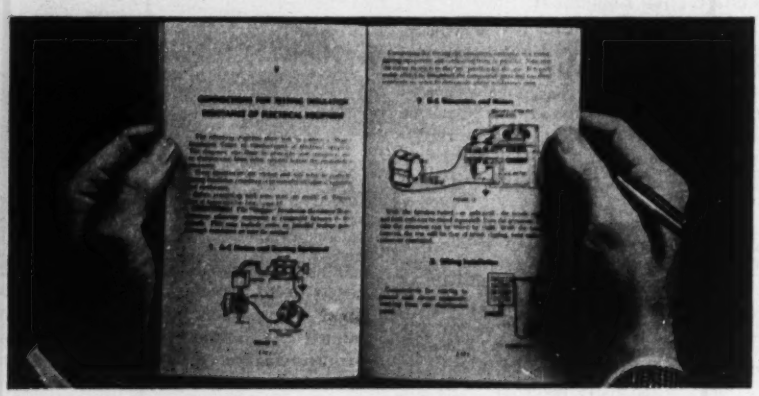
but we don't want you to miss this NEW BOOKLET on the FRAHM® Resonant Reed Principle of MEASURING SPEED

Parts of the booklet are cut away to show you the simplicity of the inner "works" of a Frahm Resonant Reed Tachometer. *There are no moving parts.* Hence, little or no maintenance is required. Speed is measured by merely touching or mounting a Frahm Resonant Reed Tachometer to any part of the casing or chassis of motor or machine. This is an important *safety* feature because readings do not have to be made in dangerous locations; they may be made at any point that is most accessible and in the best light. The booklet graphically shows you how speed is measured by resonance and read by noting the vibrations of scientifically tuned steel reeds on a scale calibrated in rpm. Many sizes, shapes and models of Frahm Resonant Reed Tachometers are offered by James G. Biddle Company covering speed ranges from as low as 900 to as high as 100,000 rpm. "Every maintenance man can use a Frahm."

Write for Booklet 312P8-ME.



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Ion Exchangers

Bulletin 1960-A describes the operation and application of ion exchange, ion exchange softening, demineralization, solids removal, alkalinity reduction, treatment of electroplating wastes, removal of contaminants from boiler feedwater, and cooling. Illustrations of equipment are included.

Bulletin 1960-A is available from Infilco, Inc., P. O. Box 5033, Tucson, Ariz.

Automatic Weighing and Proportioning Equipment

Bulletin 851 covers Merrick Weightometers, a belt-conveyor weighing unit, and Merrick Feedoweights, an automatic weighing and proportioning unit.

The bulletin has 12 pp and contains 10 applications of the Merrick equipment in such industries as cement, coal, and mining, and where feed control of pulverized or lump material is necessary. Requests should be directed to the Merrick Scale Mfg., Co., Passaic, N.J.

Chemicals Handling Equipment

A 28-page catalog of bulk material handling equipment, Bulletin 4140, has been released by the Beaumont Birch Co., 1505 Race St., Philadelphia 2, Pa. Equipment developed for the chemical and fertilizer industries, rotary feeders for both high and low pressures, bucket elevators, and chains and wheels for bucket elevators and conveyors are covered.

Applications, metals used, design, and operation are discussed for the equipment where applicable. Photographs and drawings are included. Copies are available on request.

Gas Regulation

A book on the theory of gas regulation and on the installation and maintenance of gas regulators has been issued by the engineering department of Rockwell Mfg. Co. The book has 154 pages and contains more than 120 drawings and photographs.

The eleven chapters in the book cover the following subjects: fundamental principles of regulators; selection of type and size of regulators; regulator specifications and dimensions; operation of various types of regulators; installation procedures; maintenance procedures; regulator repair; regulator capacity tables; special applications and procedures; how to order regulators; and miscellaneous tables, specifications, and data listings pertinent to the gas regulator field.

Although only Rockwell regulators are specifically described, the book covers problems common to the entire field, methods of overcoming those problems, and other general information. Bound in blue imitation leather with multiple ring binding, the handbook is available at cost from Rockwell Mfg. Co., 400 North Lexington Ave., Pittsburgh 8, Pa.

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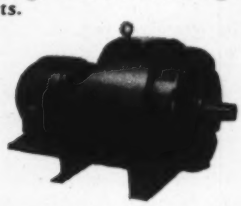

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High-Voltage Motor Control

Limitamp high-voltage motor control, its operation and application are described in a 16-page booklet announced by the General Electric Co., Schenectady 5, N.Y. The control is intended for voltages to 4800 v with interrupting capacity of 60,000 amp.

Powdered-Metal Compacting Press

Bulletin No. 3104, recently released by Baldwin-Lima-Hamilton Corp., Philadelphia 42, Pa., describes the Model L 50-ton powdered-metal compacting press, and lists its design specifications.

A table of its features explains that the press is designed for high-quality, low-cost production in the fabrication of parts from metal powders.

Drop Forging

A booklet on drop forging has been issued by The Billings & Spencer Co., Hartford, Conn. The literature contains a brief history of the company, a short description of how drop forgings are made, and information on the Billings & Spencer facilities for producing drop forgings.

The booklet has been prepared to familiarize users of commercial drop forgings with the company, which is said to be one of the oldest in the nation. Copies of the booklet are available upon request.

Compression Stills

Badger Mfg. Co., Cambridge 41, Mass., has issued Bulletin No. CP-10, describing its compression still for producing pure pyrogen-free water of laboratory purity in production volumes. The bulletin discusses the operating principle, economy of production, and outstanding design features.

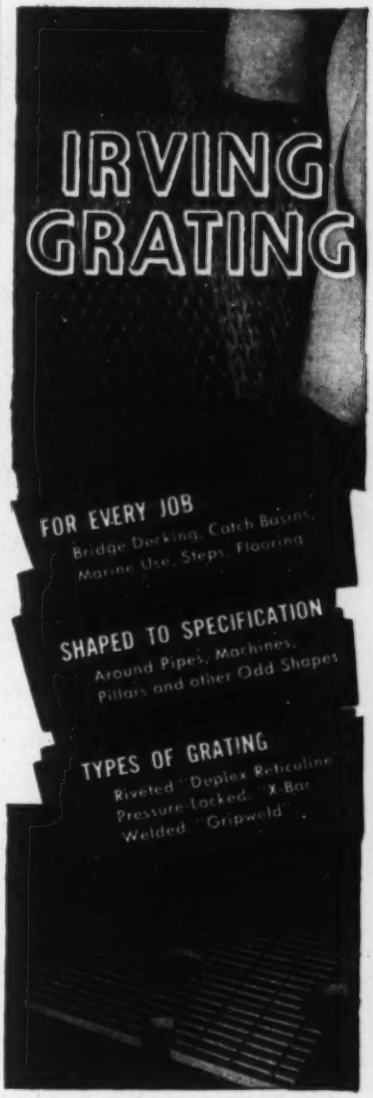
Once the initial charge had been brought to boiling point and the unit is functioning at capacity, auxiliary heat normally can be shut off, depending upon the temperature of the incoming feed, the manufacturer says, because compression usually provides the necessary heat thereafter. Copies of the bulletin are available on request.

Prefabricated Concrete-Pouring Forms

Atlas Compo Form Div. of Irvington Form & Tank Corp. has released a four-page bulletin on their prefabricated forms for concrete structures. The forms are made of plywood with steel frames, in heights of 4, 5, 6, 7, and 8 ft and widths of 12, 16, 18, 20, and 24 in. Area and weight are given for each combination of size. The advantages of Atlas Compo Forms and of the modular method of concrete-forming are discussed.

Copies of the leaflet will be sent on request by the Irvington Form & Tank Corp., 20 Vesey St., New York 7, N.Y.

FITTING EVERY WAY



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● Niagara Aero Heat Exchangers provide faster and more accurate cooling to specified temperatures for liquids in many industrial processes. They help lower production costs.

Cooling by the evaporative principle, they transfer heat to air, which is easily disposed of, and consume less than 5% of water used in conventional cooling methods. A Niagara Aero Heat Exchanger replaces both shell-and-tube cooler and cooling tower, and saves piping and pumping. Its savings quickly return its cost.

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Successful applications also include control of temperatures for jacket coolants for engines, hydraulic equipment, transformers and electronic sets, and special industrial equipment.

Write for Bulletin No. 120

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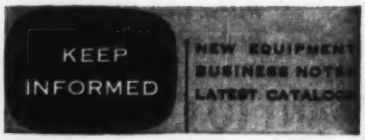


Foundry Mechanization

Link-Belt Co.'s complete line of equipment for mechanization of ferrous and nonferrous foundries and its use in increasing production and producing better castings are covered in the 40-page book No. 2423, sent on request.

Descriptions of sand preparation and mold, core, casting, and sand handling equipment are supplemented by over 70 pictures of installations. Seven foundry layouts, each pertaining to a different type and capacity of operation, are given in two-color drawings.

Sand preparation equipment described includes Roto-Louvre dryers and coolers for core sand; mullers and paddle mixers to knead and mix sand and bonding materials; revivifiers to disintegrate, blend, and cool sand; screens for the removal of foreign matter from sand; and belt, oscillating, and apron conveyors to handle sand from and to work areas; table and belt feeders for withdrawal of sand from storage hoppers; and bucket elevators to elevate sand.

Mold handling equipment described includes Link-Belt's Tru-Trac car-type conveyors, track mounted and propelled by means of steel chain; pallet conveyors available in three types (roller, sliding, and dumping); and trolley and roller conveyors. Link-Belt heavy-duty foundry shakeout installations are pictured. Apron, trolley, and oscillating conveyors for handling castings are also described.

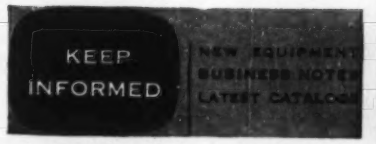
Austenitic Stainless and Nickel Chromium Steels

The International Nickel Co., Inc., 67 Wall St., New York 5, N.Y., has announced the following publications, available

Impact Tests of Welded Austenitic Stainless Steels, Bulletin A-165, 2 pages, contains impact data from tests at room temperature, −105 F, and −320 F of various types of stainless steel plate material and weld metal which permit comparison of the effect of weld rods of different analyses and the effect of heat treatments. The weld metals tested included AISI Types 301, 302, 304, 308, 310, 316, 317, 318, and 347 (the last with both lime- and titania-coated electrodes).

Effect of Temperatures on the Mechanical Properties, Characteristics, and Processing of Austenitic Stainless Steels, Bulletin A-162, 36 pages, with 32 tables and charts. The processing (such as rolling) of commercial chromium-nickel stainless steels at subzero temperatures is shown to enhance the mechanical properties. Improvement in ductility is discussed in terms of its relation to the forming process. The effects of intermittent low-temperature and high-temperature service on properties at room temperature are determined.

Nickel-Chromium Steels Types 3200-3300-3400 Series and Krupp Steel, Bulletin NS-5, 8 pages. Twenty-eight charts present a digest of information on the composition, heat treatment, transformation characteristics, and mechanical properties of the standard AISI and SAE nickel-chromium steels.



Dual-Fuel Engine

Worthington Corp. has announced a bulletin on dual-fuel engines for REA generating stations, sewage disposal, private utility, municipal power, pipeline pumping, industrial power, and irrigation and drainage.

In the 36-page book, known as Bulletin S-500-B57, are photographic examples of each application, together with statistics, case histories, and comments on fuel consumption.

A page or more is devoted to each feature of the engines.

The bulletin is obtainable by writing to Advertising and Sales Promotion Dept., Worthington Corp., Harrison, N.J., referring to Bulletin S-500-B57.

Thermocouples and Accessories

A new edition of its 36-page bulletin, "Thermocouples and Accessories," has just been issued by The Foxboro Co., Foxboro, Mass.

Listed, with specifications, are standard thermocouples for all applicable temperature ranges. Separate sections are devoted to the tubular-type (Pyod and Baby Pyod) iron-constantan couples, wire-type iron-constantan and copper-constantan couples, and Chromel-Alumel alloy and platinum couples.

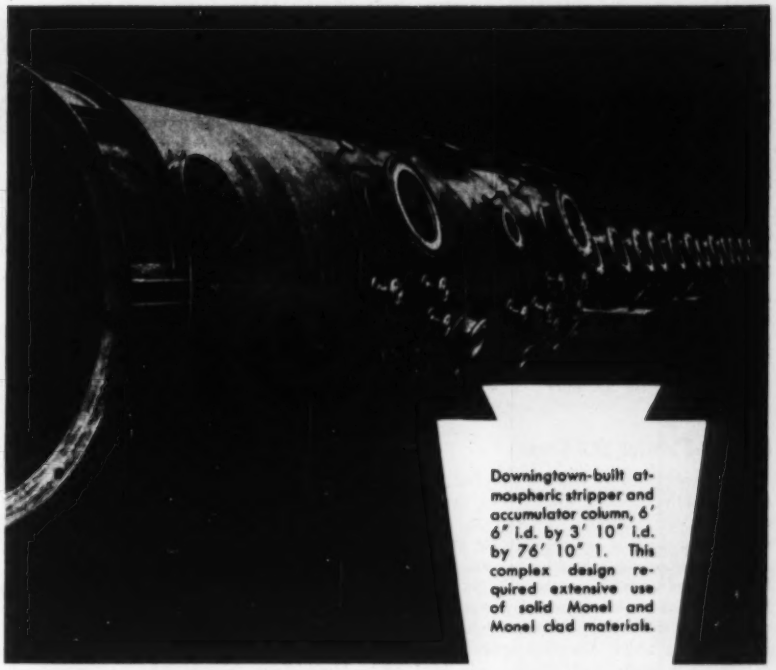
In addition to complete parts lists for each type, there are catalogued sections devoted to couple supplies and accessories, such as connection heads, protection tubes, Flintex porcelain insulators, sheaths, stuffing boxes, extension wire and bulk thermocouple wire.

Valuable as a reference manual, Bulletin 235-5 will be sent on request to users of pyrometric instruments.

Prefabricated Metal Wall Panels

Prefabricated wall panels and insulated metal walls claimed equivalent or better than 16-in. masonry walls in terms of overall *U* factor are described in Catalog B-54-B of the R. C. Mahon Co. A folder is included with the catalog which contains the test results of the coefficient of transmission *U* for the Mahon Insulated Steel Wall and several kinds of brick, concrete, and concrete-block construction.

The insulated steel walls are of two kinds, field-constructed and prefabricated. Field-constructed walls are either "fluted" style or ribbed; both contain 2 in. of Fiberglas insulation, and in both styles the panels are assembled with the insulation in the field. The prefabricated wall panels are either "fluted" or flush on both sides, and are already assembled with $1\frac{1}{2}$ in. of Fiberglas insulation. Materials, construction, erection, and thermal properties are summarized for each style, and a page of specifying instructions and two pages of construction details complete the 12-page catalog. The booklet and the test-results folder are available from the R. C. Mahon Co., Detroit 34, Mich.



Downingtown-built atmospheric stripper and accumulator column, 6' 6" i.d. by 3' 10" i.d. by 76' 10" l. This complex design required extensive use of solid Monel and Monel clad materials.

No Design Too Complicated

Order plate fabrication from Downingtown Iron Works. That's the easy way to turn your complex designs into smooth-working process equipment—the sure way to be sure of skillful workmanship in every detail.

Downingtown is thoroughly experienced in fabricating pressure vessels from various grades of carbon steel, stainless steels, nickel clad, stainless clad, Monel clad, cupro nickel, aluminum and other materials. We've developed special welding procedures—approved by ASME for code work—which enable us to produce sound welds which are extra strong and extra neat. Welds are X-ray inspected as required.

We're set up to fabricate pressure vessels of all kinds in full compliance with ASME and other code requirements. Our experienced Engineering Department will be glad to work with you on your next project. Write for helpful literature.

DOWNINGTOWN IRON WORKS INC. Hackney

DOWNINGTOWN IRON WORKS, INC.

HEAT EXCHANGERS—TOWERS—PRESSURE VESSELS
STORAGE TANKS—STEEL AND ALLOY PLATE FABRICATION

Downingtown, Pennsylvania

New York office: 52 Vanderbilt Avenue, New York 17, N. Y.

DIVISION OF

Pressed Steel Tank Company

MANUFACTURER OF HACKNEY PRODUCTS

Milwaukee 14, Wisconsin

CONTAINERS AND PRESSURE VESSELS FOR GASES, LIQUIDS AND SOLIDS

KEEP INFORMED

NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Industrial Fans

A 64-page Catalog No. 20 illustrates and describes Aerovent fans and accessory equipment. The catalog contains engine-ring, installation, and operating data for standard and special-duty fan applications, together with pertinent information for the calculation of duct sizes, friction losses, and performance and horsepower requirements.

The catalog is available by writing to Aerovent Fan Co., Inc., Piqua, Ohio.

Grating-Flooring and Treads

The Irving Subway Grating Co., Inc., has announced its Catalog F400. The catalog contains illustrations, descriptions, and engineering data on grating-flooring, treads, and floor armoring, including riveted, press-locked, and welded types. Applications recommended are for industrial, power plant, and refinery walkways, stairways, driveways, and trucking aisles; for ship catwalks and engine-room floors and treads; for locomotive, freight car, and passenger car runways and treads; for roadway armoring, expansion joints, and catchbasin covers; and for bridge decking.

Requests for the catalog should be sent to the Irving Subway Grating Co., Inc., 50-09 27th St., Long Island City, N.Y.

Tachometers

A 4-page leaflet on tachometers has been published as Tachometer Bulletin No. 1046 by Herman H. Sticht Co., Inc., 27 Park Place, New York 7, N.Y.

Nine tachometers are illustrated, and their special features and applications are described. Ranges for each model of the tachometers are given covering speeds as low as 1 rpm and as high as 100,000 rpm. Additional literature is listed. Copies of Bulletin No. 1046 are available on request.

Chains

Bulletin 53-56, describing Rex Z-Metal Chain, is available from Chain Belt Co., Milwaukee 1, Wis. Rex Z-Metal Chain is made of heat-treated, alloyed ferrous metal. It has physical properties claimed equal to the better grades of steel. Pins of Rex Z-Metal Chain are of heat-treated high-carbon steel.

The bulletin describes the user benefits of Rex Z-Metal Chain, includes reports of laboratory tests and field applications, and contains a pictorial presentation of available Z-Metal chain.

Copies of the bulletin are obtainable from Chain Belt Co., Dept. P.R., Milwaukee 1, Wis.

V-Belts

A new eight-page v-belt catalog has been published by The B. F. Goodrich Industrial Products Div., Akron, Ohio, and is available without charge. BFG patented grommet belts in standard- and high-capacity constructions are featured.

Cutaway drawings illustrate the grommet construction. Nine tables and a page of step-by-step instructions assist in figuring a v-belt drive.

Coolant Pumps

A 66-page catalog of its Gusher coolant pumps has been published by the Ruthman Machinery Co. Photographs, drawings, and capacities are given for each of the models of the following types: immersed, motor-driven; pipe-connected, motor-driven; flange-mounted, external-discharge, motor-driven; flange-mounted, internal-discharge, motor-driven; shaft- and pulley-driven; and mounting brackets and tanks. In addition, the catalog contains a section of general information.

The catalog is plastic-bound and thumb-indexed, and will be sent on request by the Ruthman Machinery Co., Cincinnati 2, Ohio.

IS THIS YOUR CONTROL PROBLEM?

1. How to indicate a change in resistance through a filter due to a clogging of the filter?
2. How to indicate a change in differential across an orifice due to a change in air flow conditions?
3. How to indicate an unbalanced condition of two air ducts?

MERCOID HAS THE SOLUTION

A Diaphragm Differential Pressure Control which operates from minute changes (03 of water) in the difference between two pressures.

Ranges to cover most applications—(inches of water) 6" vac. to 6" press., and 30" vac. to 30" pressure.

MERCURY SWITCH EQUIPPED

DIFFERENTIAL PRESSURE CONTROL | EXPLOSION-PROOF HOUSING | AVAILABLE IN WEATHERPROOF HOUSING

WRITE FOR BULLETIN

THE MERCOID CORPORATION
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PHILADELPHIA 32, PA. 3137 N. Broad Street

Continuous Duty D.C. SOLENOIDS

Synchro-Start MODEL SD SOLENOIDS have an exceptional amount of power over a long stroke. The sealed casing protects these solenoids from seepage of dust and liquids. They are available with standard terminal studs (Model SD) or with the aircraft type AN Connector (Model SD-A).

Specifications—SD Solenoids can be furnished in all standard voltages up to 115 Volts D. C.

10 lb. pull over 1½ inch stroke.

Power consumption, 550 Watts pulling and 8 Watts holding.

Housing dimensions, 4⅜" x 2½".

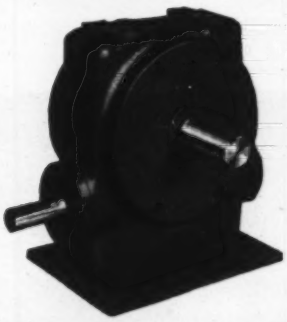
SYNCHRO-START PRODUCTS, INC.
8151 N. RIDGEWAY AVE. • SKOKIE, ILLINOIS

Manufacturers of AUTOMATIC ENGINE CONTROLS SAFETY CONTROLS • OVERSPEED GOVERNORS and CONTROL EQUIPMENT

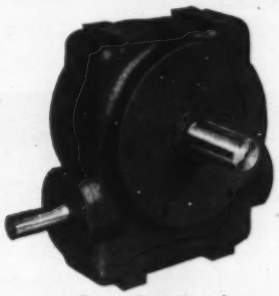
D.O.James

TYPE "S" WORM GEAR SPEED REDUCERS

RATIOS FROM 5.66:1 TO 100:1 — .04 HP TO 15.6 HP

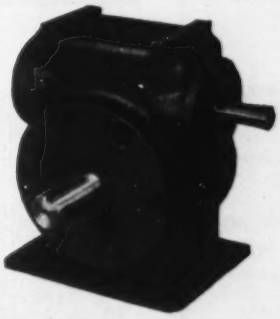


Horizontal Type—Worm at Bottom
Sizes 17S, 22S, 26S, 33S

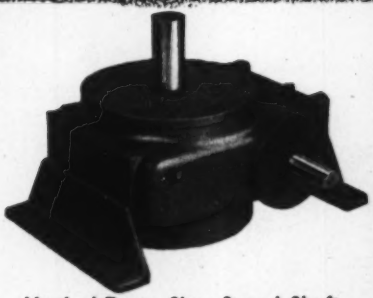


Base Removed

Sizes 17 to 33 inclusive have detachable bases or feet, are adaptable to horizontal or vertical applications, convertible from one to the other, or may be used without bases to suit particular installations.

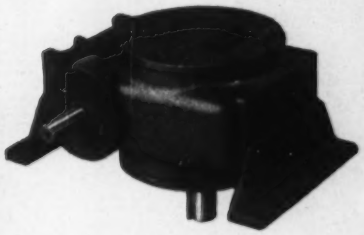


Horizontal Type—Worm at Top
Sizes 17ST, 22ST, 26ST, 33ST

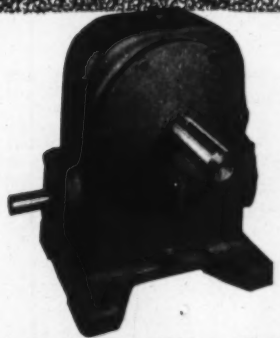


Vertical Type—Slow Speed Shaft Extends Upward
Sizes 17SV, 22SV, 26SV, 33SV

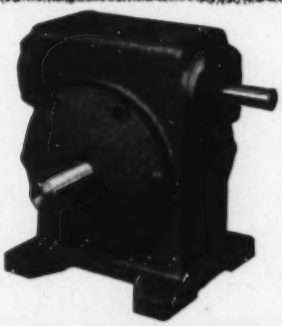
Feet Removed



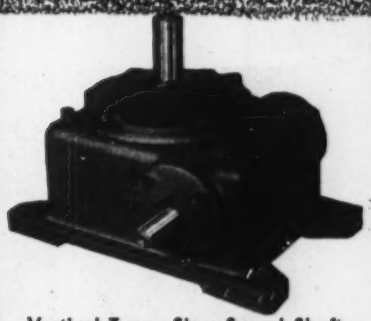
Vertical Type—Slow Speed Shaft Extends Downward
Sizes 17SV, 22SV, 26SV, 33SV



Horizontal Type—Worm at Bottom
Sizes 38S, 42S, 46S, 54S



Horizontal Type—Worm at Top
Sizes 38ST, 42ST, 46ST, 54ST



Vertical Type—Slow Speed Shaft Extends Downward or Upward
Sizes 38SV, 42SV, 46SV, 54SV

D.O.JAMES GEAR MANUFACTURING CO.

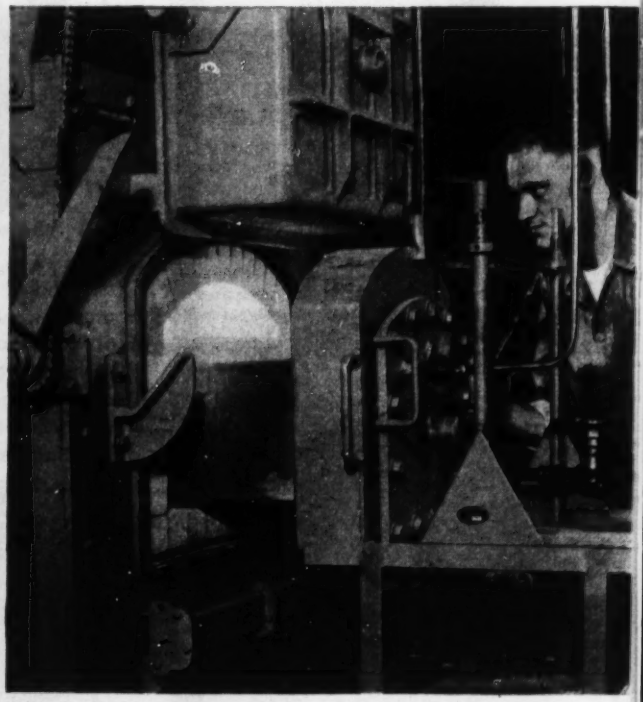
Since 1888 — Power Saving Equipment for Industry

1140 W. MONROE STREET CHICAGO, ILLINOIS

65° below to 2500° above today in

New Trane laboratory creates "terrible weather" . . . and . . . for industry, homes

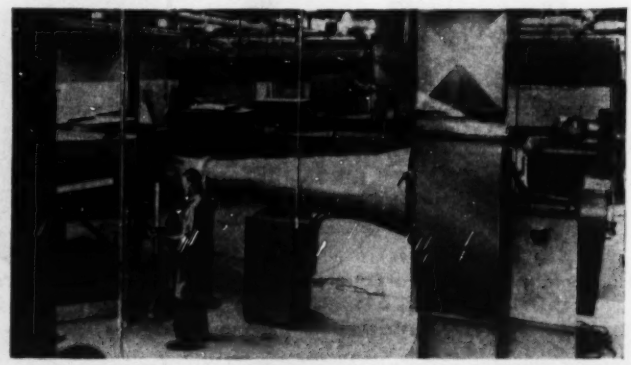
Cold as Siberia—or the stratosphere! This room, capable of creating 65-degrees-below-zero cold, is designed for testing the performance of TRANE equipment at low temperatures. Here, a radar tube cooler test set-up is being checked under conditions it might face in some bitterly cold Arctic plane-spotting station.



2,500 degrees above in this atmosphere-controlled furnace! Within this furnace may be developed new types of heat exchangers to work efficiently under the ever-climbing temperatures of new processes, much as TRANE Brazed Aluminum Surface was developed to provide a more compact, light-weight exchanger for special uses.

Chamber of silence, where a whisper is a "shout." In this soundproofed room, technicians check quiet operation of TRANE products. High standards of noise-free operations are vital.

Room-within-a-room is for rating TRANE heating equipment. Refrigerated air is circulated within the double wall, simulating winter conditions. You get assurance of *full* rated capacity from *every* TRANE unit.



More than a dozen wind tunnels provide the wide range necessary to test all types of TRANE (and other) equipment. A continuous, long-term testing program provides the complete and authoritative performance data that has made TRANE sales engineers in 90 U. S. offices and throughout the world a dependable source of help and information . . . and helps make TRANE literature outstanding in the industry. Look to TRANE for the answers to your heating, cooling and ventilating problems.

La Crosse, Wis., and 60 m.p.h. gale!

new machines to overcome it
and the nation's defense!

New TRANE Research and Testing Laboratory

WITHERING HEAT of a mile-deep African gold mine . . . the numbing cold of an Arctic military post . . . or super-temperatures encountered in new industrial processes—you may find them duplicated, any day, in the new "House of Weather Magic" at La Crosse, Wis.

It's the new TRANE Research and Testing Laboratory, an investment in time, talent and the tools of research for developing better equipment—new methods of heating, air conditioning, ventilating, heat transfer.

TRANE leadership in these fields stems from such research—research which has produced such outstanding new products as the TRANE *CenTraVac* (hermetic, centrifugal water chiller) . . . *UniTrane* multi-room air conditioning units . . . the TRANE *Unit Ventilator* for schools . . . *Delta-Flo* Heating and Cooling Coils, and many others.

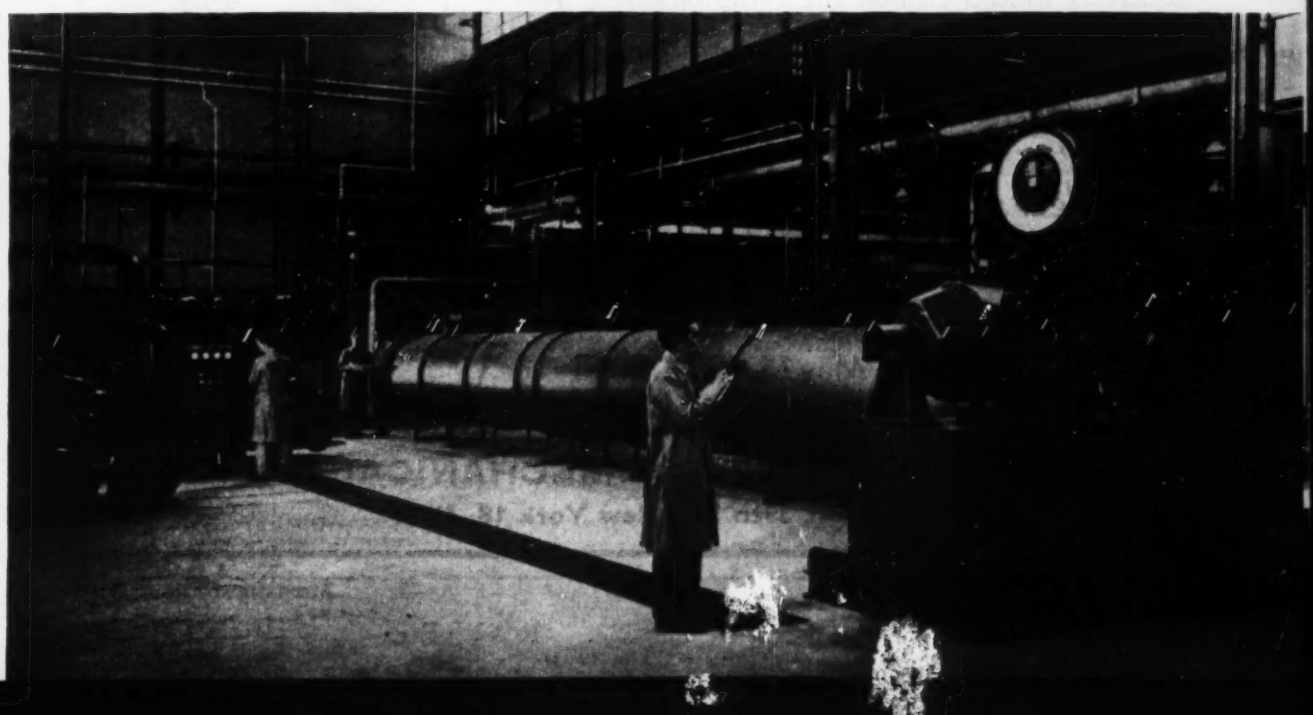
For complete information on the wide range of TRANE air conditioning and heating products, call your nearest TRANE Sales Office or write The Trane Company, La Crosse, Wis.

TRANE

manufacturing engineers of
AIR CONDITIONING, HEATING,
ventilating and heat transfer equipment

The Trane Company, La Crosse, Wis. • East. Mfg. Div., Scranton, Penn.
Trane Co. of Canada, Ltd., Toronto • 90 U.S. and 14 Canadian Offices

"Big Bertha" is the nickname given this duct used for testing large centrifugal fans. Test set-ups like this provide accurate ratings for TRANE Fans, help engineers in their never-ending search for more efficient designs, lower horsepower requirements.



STUDENT MEMBERS

OF THE ASME

you can get—

A LITTLE CASH!
A LITTLE FUN!
A LITTLE FAME!

HERE'S your opportunity to get that for which you have lacked the wherewithal. There's just one catch — you will have to work for it! If you quit easily — don't read any further. Perhaps a little extra work on your thesis will do the trick.

An engraved certificate signed by the President and Secretary of the Society will accompany each award.

A trip to the Annual Meeting as a guest of the "Old Guard" will be awarded.

Students should consult the Honorary Chairman regarding the rules for these awards. Only papers by single authors will be considered.

Each student must submit his paper to the Vice President of the Region in which his Student Branch is located not later than ***May 15, 1954.***

$150.00

For the best paper by an undergraduate on the subject "The Engineer in Business and Industry." This is the Charles T. Main Award.

An undergraduate must submit his paper for the Charles T. Main Award or Undergraduate Student Award before thirty days after the completion of his undergraduate work.

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For the best paper on an engineering subject by an undergraduate. This is the Undergraduate Student Award.

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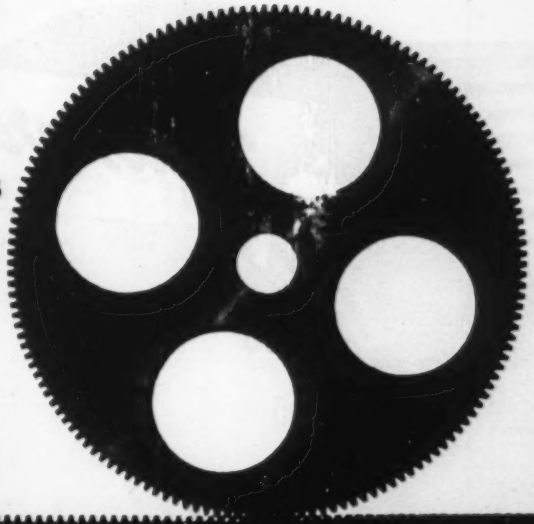
For the best paper on an engineering subject by a graduate student. This is the Postgraduate Student Award.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

29 West 39th St., New York 18, N. Y.

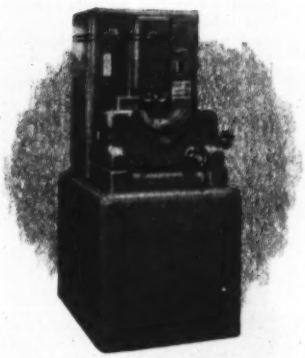
Here's *Why* you can check precision gears *more conclusively* with Kodak Conju-Gage Gear Checkers



Why the composite check

Errors in gears seldom occur individually—they're usually combinations of as many as six types of errors. The practical way to test gears for these errors is to test them in action through the composite check recommended in the new American Standard (AGMA 236.02; ASA B6.11-1951).

This check measures gear errors as variations in center distance when the gear is rotated in contact with a master of known accuracy. Since this variation is the sum of errors in both gear and master, the degree of precision measurable depends on the precision of the master.



The Kodak Conju-Gage Gear Checker automatically records the composite effects of runout, base pitch error, tooth thickness variations, profile error, lead error, and lateral runout. Illustrated is the Kodak Conju-Gage Gear Checker, Model 4U, for gears up to 4½" pitch diameter. Larger and smaller models are also available.

Why the Conju-Gage Gear Checker

Kodak Conju-Gage Gear Checkers use a master of exceptional accuracy, the Kodak Conju-Gage Worm Section. These Worm Sections are generated by the continuous action of a thread grinder under control of a precision lead screw—circular pitch error and tooth thickness variations cannot be introduced by defects in an intermittent indexing mechanism. This means a more accurate gaging element, less chance that error in the master may coincide with a tolerable error in the gear to result in a needless rejection. Less chance, too, that an error in the master may subtract from an intolerable error in the gear, passing a gear that will fail in use.

By passing each right gear, rejecting each wrong gear, the Kodak Conju-Gage Gear Checker helps you reduce costs while maintaining highest precision. For the full story of this and other economies achieved by Conju-Gage instrumentation, send for the booklet, "Kodak Conju-Gage Gear Testing Principle." Write to:

Special Products Sales Division
EASTMAN KODAK COMPANY, Rochester 4, N.Y.

CONJU-GAGE INSTRUMENTATION

. . . a new way to check gear precision in action

To inspect all kinds of complex parts on a bright screen, Kodak also makes two highly versatile contour projectors.

Kodak

The leader has lengthened its lead!

From the day it was announced, the Marsh Mastergauge took the lead in the pressure gauge field. You are probably well aware of this . . . but do you realize that we have constantly given it plus qualities to still further *lengthen* its lead?

Look at the recent developments presented opposite. Unquestionably these are the three greatest strides in gauge development since the creation of the Marsh "Recalibrator."

Yes, the three basic gauge components have been brought to a remarkable stage of perfection in the Mastergauge. Certainly, for every critical service there is no gauge to compare with it!

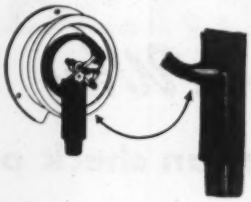
Mastergauge is standard bearer for the world's broadest line of gauges and dial thermometers, each the best of their kind in the applications for which they are recommended. Ask for data covering your specific needs.

MARSH INSTRUMENT CO. *Sales Affiliate of Jas. P. Marsh Corporation*
Dept. 29, Skokie, Ill.

ONLY MARSH HAS THE "RECALIBRATOR"

MARSH

THE STANDARD OF ACCURACY

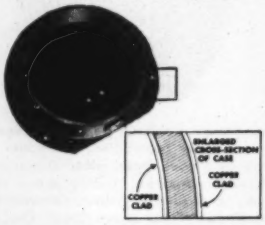


1—A better tube construction—

The Mastergauge always had the most effective joining of the bourdon tube to the socket . . . but . . . *one-piece construction is always better!* Welding these dissimilar parts posed a tough problem . . . but we finally solved it by a new process—the *"Conoweld"* process—exclusively ours. The photo of an actual section shows the perfect fusion. Socket, tube—even the end-piece—are fused into one leak-tight unit.

2—A better movement—

To convert the action of the bourdon tube into accurate pressure indication, the gauge movement must be rugged, practically frictionless, highly resistant to corrosion. A self-lubricating effect is achieved in the Mastergauge movement by using alternate stainless steel and monel—gears stainless, bushings "K" monel, and so on. A distinguishing feature is the "coined" sector gear. Note broad face of gear which results from this coined extrusion.



3—A better case—

Another development that has increased Mastergauge leadership is the new copper-clad, wrought steel case. The case has the strength of steel and the resistance to corrosion of copper. It is four times as strong as a cast iron case and one-third lighter. Finel finish is a handsome corrosion resistant black enamel. Every case is fitted with Marsh safety blow-out plug—a typical advancement.

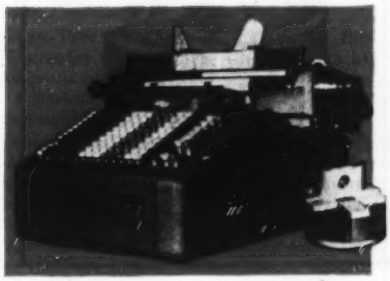
JUST A MATTER OF CONTROL

LORD ENGINEERING CONTROLS VIBRATION

. . . anywhere!

The difference between a good product and a better one is often just A Matter Of Control—control of vibration and shock which may be damaging your product. Pioneers in solving vibration problems for many industries, Lord Manufacturing Company is well qualified to assure you of better performance from your products through the use of Lord Vibration Control Mountings and Bonded-Rubber Parts. Our Engineers will be pleased to help you in the analysis of the vibration which may damage your product and in the selection of the correct method of control. Lord Engineering means Materials Research —Engineering Research—Product Design—Manufacturing Know-How for your application.

Over 27,000 designs and their variations from which to choose.



Here is one example of Lord Engineering on sensitive business machines. The Burroughs Sensimatic Accounting Machine is supported on LORD Mountings to reduce noise and cushion shock.

LOS ANGELES 28, CALIFORNIA 7046 Hollywood Blvd.
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DAYTON 2, OHIO 410 West First Street
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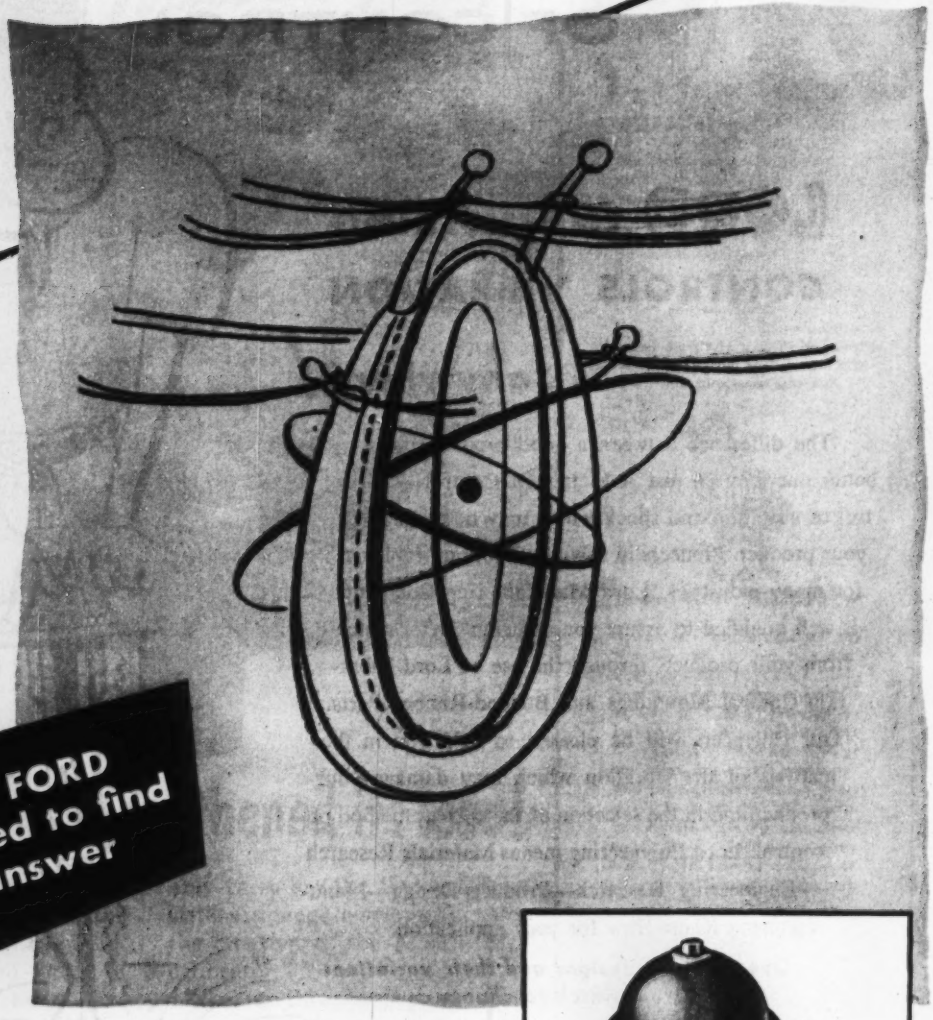
LORD MANUFACTURING COMPANY • ERIE, PA.

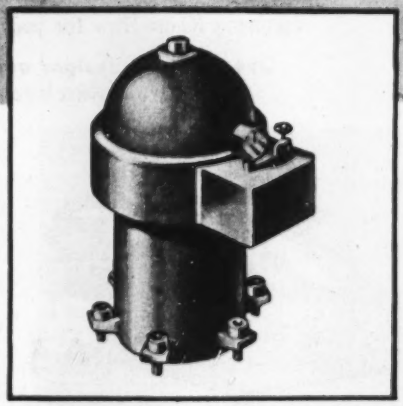
LORD BONDED RUBBER

Headquarters for **VIBRATION CONTROL** FOR 30 YEARS

HOW TO MAKE A HARNESS
for an Atom



...and FORD was asked to find the answer



Taming the monster power of a nuclear reactor requires precision control of all the elements. Ford Instrument is designing controls that seek and hold the optimum power level of the pile . . . and keep the rods so exactly set that the reactor's energy is harnessed . . . safely, securely.

This is typical of the problems that Ford has been given by the Armed Forces since 1915. For from the vast engineering and production facilities of the Ford Instrument Company, come the mechanical, hydraulic, electric, magnetic and electronic instruments that bring us our "tomorrows" today. Control problems of both Industry and the Military are Ford specialties.

19

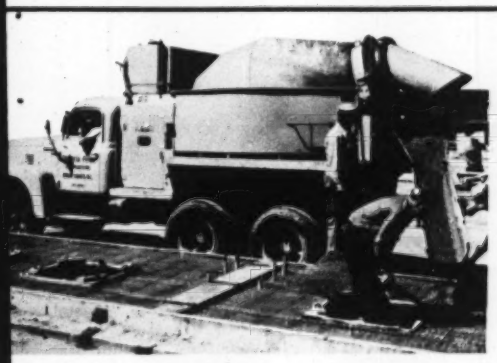
You can see why a job with Ford Instrument offers young engineers a challenge. If you can qualify, there may be a spot for you in automatic control development at Ford. Write for brochure about products or job opportunities. State your preference.

FORD

FORD INSTRUMENT COMPANY
DIVISION OF THE SPERRY CORPORATION
31-10 Thomson Avenue, Long Island City 1, N. Y.

New facts for your file on U·S·S HIGH STRENGTH STEELS

Truck body platform frames built of USS COR-TEN steel are 20% lighter...4 to 6 times more rust resistant



In truck mixer parts, USS MAN-TEN steel adds strength, increases resistance to abrasion, impact and vibration

In this 4½ cu. yd. Lite-weight, Heavy Duty Hi-Boy Truck Mixer built by Blaw-Knox Company, Pittsburgh, Pa., the mixing drum, mixing blades, charging hopper and discharge chute are made of USS MAN-TEN steel. In all these parts which are subjected to the highly abrasive action of the concrete batch, MAN-TEN steel's greater resistance to abrasion plays an important part in prolonging life and keeping maintenance costs and down-time to a minimum.

MAN-TEN steel's high endurance limit, 40% greater than carbon steel, and its high yield point of 50,000 psi are additional properties that pay off in increasing the durability of this equipment.

During the past 20 years, USS High Strength Steels—USS COR-TEN, USS MAN-TEN and USS TRI-TEN—have been used in materials-handling, road-building and excavating equipment of all kinds to reduce weight, increase working capacity and to give it the stamina to stay on the job.

Find out how these "steels that do more" can be applied to improve your equipment—how readily they can be fabricated—and how little they cost to use. A letter to our nearest district office will bring you this information.

By using 10-gage USS COR-TEN steel in place of 8-gage hot rolled carbon steel, Giant Manufacturing Co., Council Bluffs, Iowa, obtains maximum strength with minimum weight in the platform frames of their farm truck bodies.

This construction, which gives farmers and truckers several hundred pounds more loading capacity in these units—and thus cuts transportation cost per mile of load—has been used almost exclusively in Giant trucks since 1946.

"During this time," says the manufacturer, "we have not had a failure due to distortion or corrosion of the platform frames. Our fabrication department states that shearing and forming USS COR-TEN steel, using power equipment, is comparable to equal gages of regular carbon steel. COR-TEN steel's welding properties are excellent . . . it is easily prepared for application of enamel finish and has absolutely no tendency to flake or peel the finished coat."

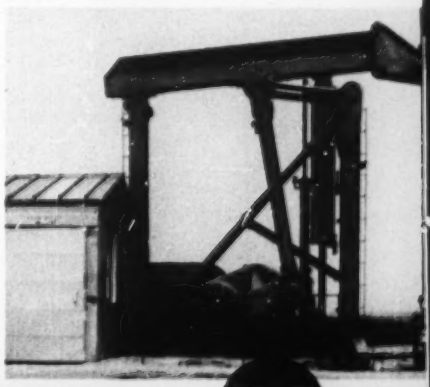
Another well-known builder of farm wagons says, "We have found that the use of high strength steels is almost a must in the manufacture of farm equipment. All farm implements are subject to terrific abuse in the field and are generally without any protection whatsoever from the elements. The anti-corrosive qualities of high strength USS COR-TEN steel are naturally a major selling point in equipment of this type."

USS MAN-TEN steel saves weight, ensures longer life, in air-balanced oil pumping unit

Designers of equipment for the oil industry have found in USS High Strength Steels an economical and practical solution of many of their problems. How to reduce weight? How to increase strength? How to resist corrosion? How to prolong life?

Typical is this application of USS MAN-TEN steel in the walking beam of this ultra-modern air balanced pumping unit built by the Parkersburg Rig and Reel Company, Parkersburg, W. Va.

By using USS MAN-TEN steel construction in the 24 in. walking beam in place of carbon steel, the weight of this important member has been reduced 16.6%. Yet, because USS MAN-TEN steel has a yield point of 50,000 psi—one and a half times that of carbon steel—the lighter beam is much stronger. Additional durability is ensured by the fact that MAN-TEN steel has 40% higher fatigue strength, thus providing greater resistance to vibration and reversal of stresses.



USS

UNITED STATES STEEL

New facts for your file on U·S·S CARILLOY STEELS

Improved suspension system of "Patton 48" features torsion bars of Carilloy steel

● In the army's newest medium tank, the Patton 48, torsion bars made from U·S·S Carilloy steel do a better job of cushioning riding shocks and take less mounting space than suspension systems used in World War II tanks.

In rugged field tests of the Patton 48, the torsion bars constantly flex, twist, and vibrate as the tank rumbles over trenches and scales 3-foot walls. U·S·S Carilloy 8660, a high quality electric furnace steel, performs exceptionally well in this torturous service.

U·S·S Carilloy steels are solving many tough jobs like this in both military and civilian applications. And it will pay you to look for a Carilloy steel when you need maximum strength, light weight, good corrosion resistance, or any combination of these properties in heavy-duty parts that must be small in size.

Cost cut 75% on wing flap supports with Rolled Structural T-sections of Carilloy steel

By switching from 2¼" x 3¼" alloy steel *bars* to hot-rolled T-sections of U·S·S Carilloy 4140 steel, J. C. Peacock Company and Consolidated Vultee Aircraft Corporation have reduced the cost and *improved the quality* of wing flap supports for Model 340 Convair airliners.

Flap tracks made of Carilloy T-sections not only are stronger than those formerly used, but require 4 hours less machining time and are machined with 60% less scrap loss. Finished tracks now cost only one-fourth as much as they used to.

As J. C. Peacock and Convair did, you will find exactly the alloy steel you need in U·S·S Carilloy. Carilloy steels are produced in the widest available range of analyses, sizes, forms, and heat treatments. They readily meet with the highest quality standards. If you need alloy steel of *any type* get in touch with our nearest District Sales Office.

U·S·S Carilloy steel produced in wide variety of plate, sheet, and strip

You can order flat-rolled *Carilloy* steel in anything from a razor blade strip to armor plate for a battleship. In U·S·S Carilloy, you get the widest selection of alloy steel plate, sheet, and strip that is obtainable from one producer. One source of supply makes purchasing easier, assures you consistent quality, and simplifies manufacturing problems.

Remember, too, when you buy Carilloy steels you have at your service, every day, the best metallurgical talent available. Our metallurgists have intimate knowledge of all types of alloy steels and their most economical fabrication. These men often can help you cut costs by offering practical suggestions on engineering and production.

For more information about Carilloy plate, sheet, and strip, and for free metallurgical assistance, get in touch with our nearest District Sales Office.

USS

New facts for your file on

U·S·S STAINLESS STEEL

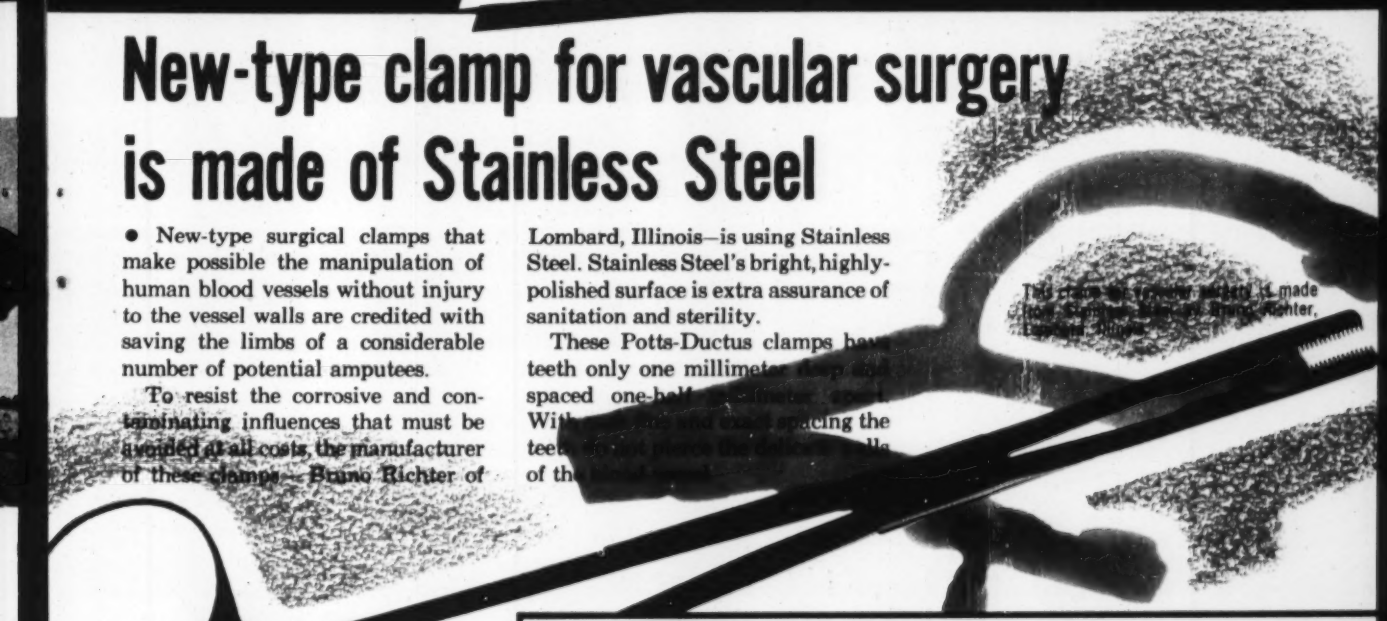
SHEETS · STRIP · PLATES · BARS · BILLETS · PIPE · TUBES · WIRE · SPECIAL SECTIONS

New-type clamp for vascular surgery is made of Stainless Steel

• New-type surgical clamps that make possible the manipulation of human blood vessels without injury to the vessel walls are credited with saving the limbs of a considerable number of potential amputees.

To resist the corrosive and contaminating influences that must be avoided at all costs, the manufacturer of these clamps—Bruno Richter of Lombard, Illinois—is using Stainless Steel. Stainless Steel's bright, highly-polished surface is extra assurance of sanitation and sterility.

These Potts-Ductus clamps have teeth only one millimeter deep and spaced one-half millimeter apart. With fine and exact spacing the teeth [illegible] of the blood vessel.



This clamp for vascular surgery is made from Stainless Steel by Bruno Richter, Lombard, Illinois.

Gleaming Stainless Steel adds attractive appearance and a host of other benefits to the employee cafeteria at H. J. Heinz Company, Pittsburgh. It was fabricated by Tyson Metal Products Company, Pittsburgh.

Take advantage of Stainless Steel in your designs and in your selling

Here are more applications typical of the thousands in which Stainless Steel has been used to improve design and add sales appeal. The wide range of valuable properties available in Stainless Steel makes it the ideal material for many, many jobs.

Put Stainless to work for you. It will pay its own way and give you a good return on your investment—especially when it is perfected, service-tested U·S·S Stainless Steel.

USS

Stainless Steel's ease of cleaning makes it best for cafeteria use

Food handling is a "natural" for Stainless Steel. Stainless gives you an unmatched combination of sanitary qualities, ease of cleaning, a smooth, non-porous surface, resistance to corrosion and long life.

This cafeteria equipment was fabricated for H. J. Heinz Company, Pittsburgh, Pa., by Tyson Metal Products Company, Pittsburgh. It is made of a nickel-chromium grade of Stainless Steel.

BLACKSTONE CORPORATION

Reduces Weight and Cost

with

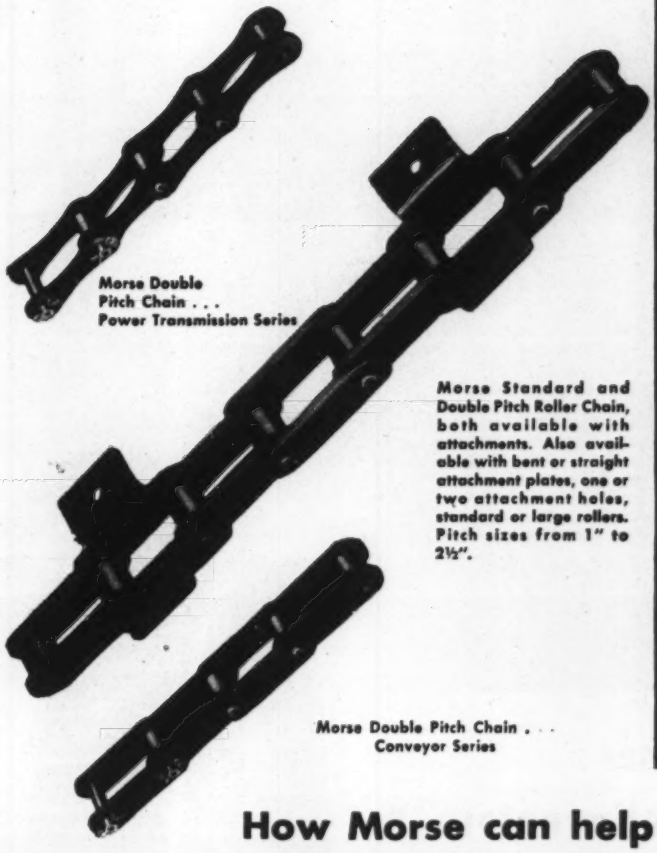
PARKER DIE CASTINGS

BLACKSTONE'S Full-Automatic Washer with the new flexible cycle is a distinct improvement over previous types. Today's housewife knows new leisure because of Blackstone's advanced engineering and design. For instance, the three parts shown here are Parker Die Castings. Costs are lowered since machining is virtually eliminated. Weight has been reduced without loss of strength. Parker Die Castings are in use in nearly every industry—cast to exacting alloy and design specifications by experienced Parker craftsmen. Call on Parker engineers the next time you need die castings. Each of us will profit.

and when you think of Die Castings THINK OF

Parker White Metal Company • 2153 McKinley Ave., Erie, Pa.

PARKER ALUMINUM *and* ZINC *Die Castings*



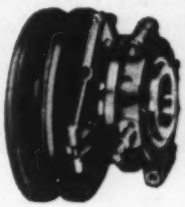
Morse Double Pitch Chain . . . Power Transmission Series

Morse Standard and Double Pitch Roller Chain, both available with attachments. Also available with bent or straight attachment plates, one or two attachment holes, standard or large rollers. Pitch sizes from 1" to 2½".

Morse Double Pitch Chain . . . Conveyor Series

Torque-Limiter . . . Slip-type friction device for automatic overload protection.

Morse Full-Complement Cam Clutch . . . (series-200) stops reverse shaft rotation; prevents rollback of conveyor feed mechanism.



Morse-Rockford Over-Center Friction Clutches, 4 basic types, hp ranges from .57 to 1.7 per 100 rpm.

How Morse can help you solve your automation problems right now

Since it is true that the advantages of automation depend upon the accuracy and non-stop qualities of machinery, the need for power transmission products which are dependable, smoothly operating, practicable and economical becomes more apparent.

It's true, too, that the change from manually operated to fully automatic machines on existing production lines must be feasible and economical. And that's where Morse comes in.

Morse Chain Company offers you a complete line of power transmission products (see below). There is a type for almost every need, whether it's positioning, timing, conveying, or power transmission, with a wide range of sizes within each type. Furthermore, Morse products can be secured easily —for the most part, off the shelf of your distributor.

It costs no more to deal with the leading manufacturer of quality power transmission products. And the Morse extensive line is one long recognized for its precision, durability and economy.

Why not write today for more information on how you can benefit through the use of the Morse product line now, in this age of automation. MORSE CHAIN COMPANY, 7601 Central Avenue, Detroit 10, Michigan.

MORSE

MECHANICAL POWER TRANSMISSION PRODUCTS

FOR 24 REASONS, MASTERS OF MECHANICAL POWER TRANSMISSION SINCE 1893

Two Terry Turbines equipped with "trouble eliminators"

Because these turbines have solid wheels, they can take a lot of abuse, without complaint. Here's why:

1. The wheel has no separate parts to become loose or work out. It is a single forging, in which a series of semi-circular buckets is milled.

2. Blade wear is of little consequence because the power-producing action of the steam takes place on the curved surfaces at the back of the buckets. Wear does not materially affect horsepower or efficiency.

3. The blades cannot foul. There is a one inch clearance on either side of the wheel and, in addition, the blades are double rim protected. There is no need for close axial blade clearance, because the steam enters the buckets in a direction at right angles to the shaft.

For complete details of these *work horses of industry*, send for a copy of bulletin S-116. No cost or obligation.

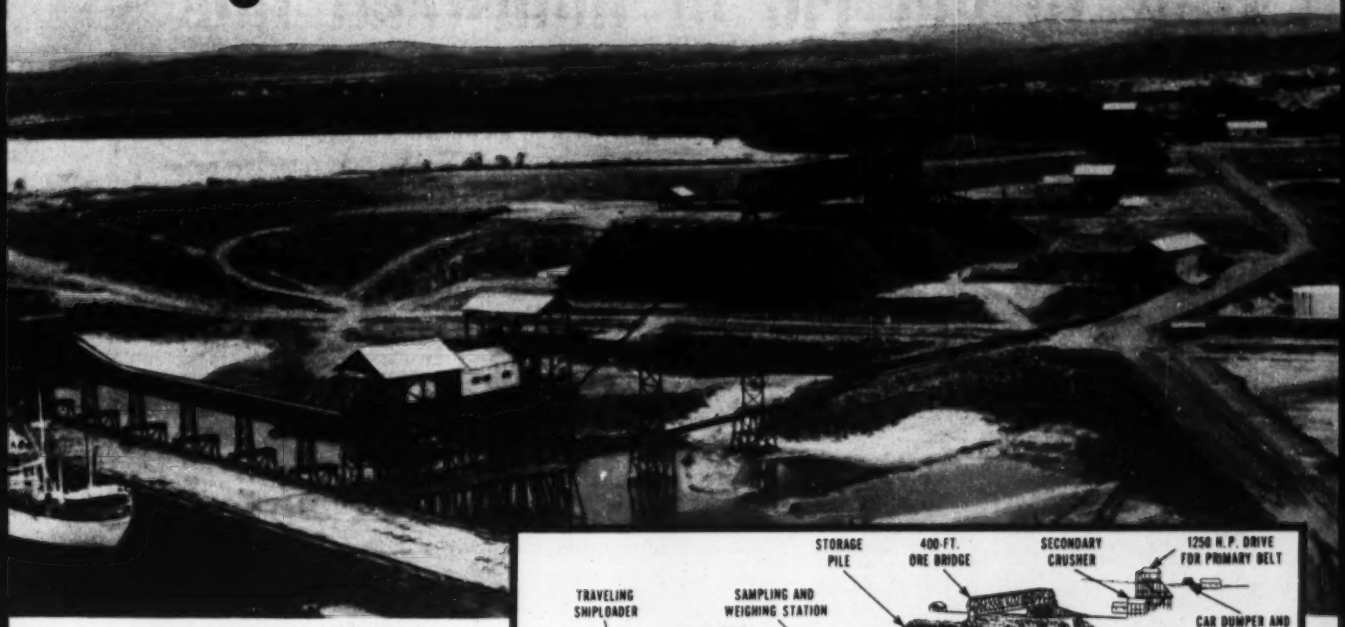
THE TERRY STEAM TURBINE CO.

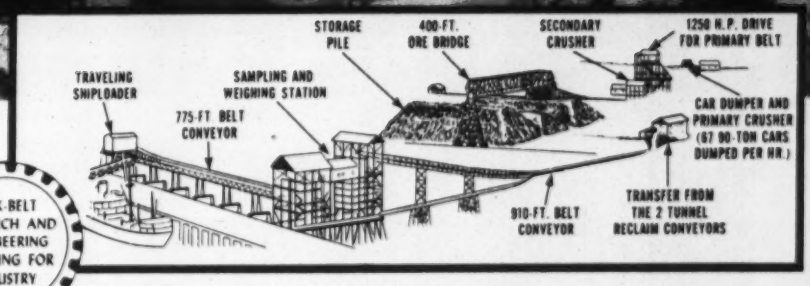
TERRY SQUARE, HARTFORD 1, CONN.

TERRY

TT-1199

Moving Venezuelan iron ore to the sea




STORAGE PILE
400-FT. ORE BRIDGE
SECONDARY CRUSHER
1250 H.P. DRIVE FOR PRIMARY BELT
TRAVELING SHIPLOADER
SAMPLING AND WEIGHING STATION
775-FT. BELT CONVEYOR
CAR DUMPER AND PRIMARY CRUSHER (67 90-TON CARS DUMPED PER HR.)
910-FT. BELT CONVEYOR
TRANSFER FROM THE 2 TUNNEL RECLAIM CONVEYORS

Aerial photograph and schematic flow sheet trace ore's movement from railhead to ship. Below: Link-Belt belt conveyors along dock and boom load a ship. The facility may be expanded, when necessary, to load ships at 12,000 long tons per hour.

LINK-BELT RESEARCH AND ENGINEERING WORKING FOR INDUSTRY

Link-Belt fulfills a single-contract responsibility for design, fabrication and erection of giant ore handling system at Puerto Ordaz

TO MOVE Cerro Bolivar's ore from mine car terminal to ocean-going ships, U. S. Steel's Orinoco Mining Co. appointed Link-Belt the prime contractor. The project was engineered, fabricated and installed in 23 months—approximately five months ahead of schedule. This was accomplished with the excellent cooperation of suppliers and of our subcontractors, Wellman Engineering Co., and McDowell S. A. of Caracas.

As the ore moves via Link-Belt belt conveyors to the ships, it is crushed in two stages. En route it is also stock-piled, to be reclaimed as needed at a rate of up to 6000 long tons per hour. The shiploader is versatile enough to handle all types of ocean-going ships plus a 39-ft. annual water level variation of the Orinoco river. One shiploader operator electrically controls the speed and capacity of the entire reclaiming system—from storage pile to the ship.

Although the Puerto Ordaz project is extremely large, it typifies the service offered by Link-Belt. Under a single contract, Link-Belt offers unified responsibility for complete materials handling and processing plants — from design to successful operation. A call to your nearby Link-Belt sales office will place the facilities of this comprehensive organization at your service.

LINK-BELT

One source . . . one responsibility for materials handling and power transmission machinery

LINK-BELT COMPANY: Executive Offices, 307 N. Michigan Ave., Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World. 13,402

How to get rid of industrial fumes

American Blower Fans help get rid of fumes in this catalytic fume disposal installation at a modern chemical plant.

Revolutionary, new Catalytic Combustion process uses American Blower Fans to help convert hazardous industrial fumes to odor-free, color-free gases

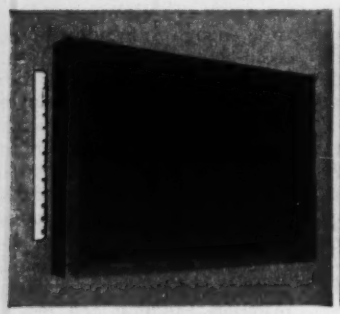
An ingenious, low-temperature oxidation process developed by the Catalytic Combustion Corporation, Detroit, Michigan, uses American Blower Fans to help convert organic industrial fumes into odorless, colorless (and harmless!) gases – plus useful heat energy.

The secret of this fume-destroying system is the Suter-Ruff Catalytic Element: a closely packed mat of heat- and corrosion-resistant metallic ribbons, coated with platinum alloy, and conditioned to produce catalytic action.

Catalytic Combustion occurs when burnable fumes are passed through this catalytic element. Fume destruction is complete, whether fumes are present in traces or heavy concentrations.

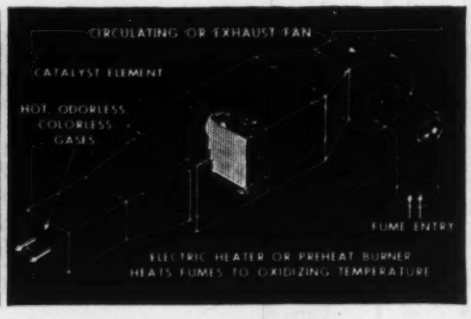
Good velocity and distribution of fumes through the mat is a *must* for effective use of the entire catalyst area. Catalytic Combustion Corporation relies on American Blower Fans in its installations to do this important job; they've found that American Blower Fans are efficient, long lived, quiet in operation.

If *you* have an air-handling problem, feel free to call on American Blower engineers—any time. Just phone your nearest American Blower or Canadian Sirocco Branch Office.



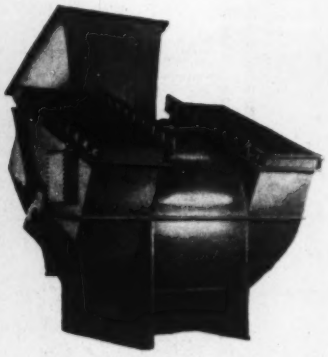
Suter-Ruff Catalytic Element

Small in size, the Suter-Ruff Catalytic Element is capable of handling large volume. During fume oxidation, temperatures jump as much as 600° F. – furnishing heat that may be utilized in manufacturing.


CIRCULATING OR EXHAUST FAN
CATALYST ELEMENT
HOT, ODORLESS COLORLESS GASES
FUME ENTRY
ELECTRIC HEATER OR PREHEAT BURNER HEATS FUMES TO OXIDIZING TEMPERATURE

The Catalytic Combustion Process

For catalysis to take place, fumes must be preheated with an electric heater or preheat burner. American Blower fans provide the needed mixing, circulation and exhaust of fumes at elevated temperatures. Catalytic Combustion eliminates fire hazards, condensate in ducts, air pollution.



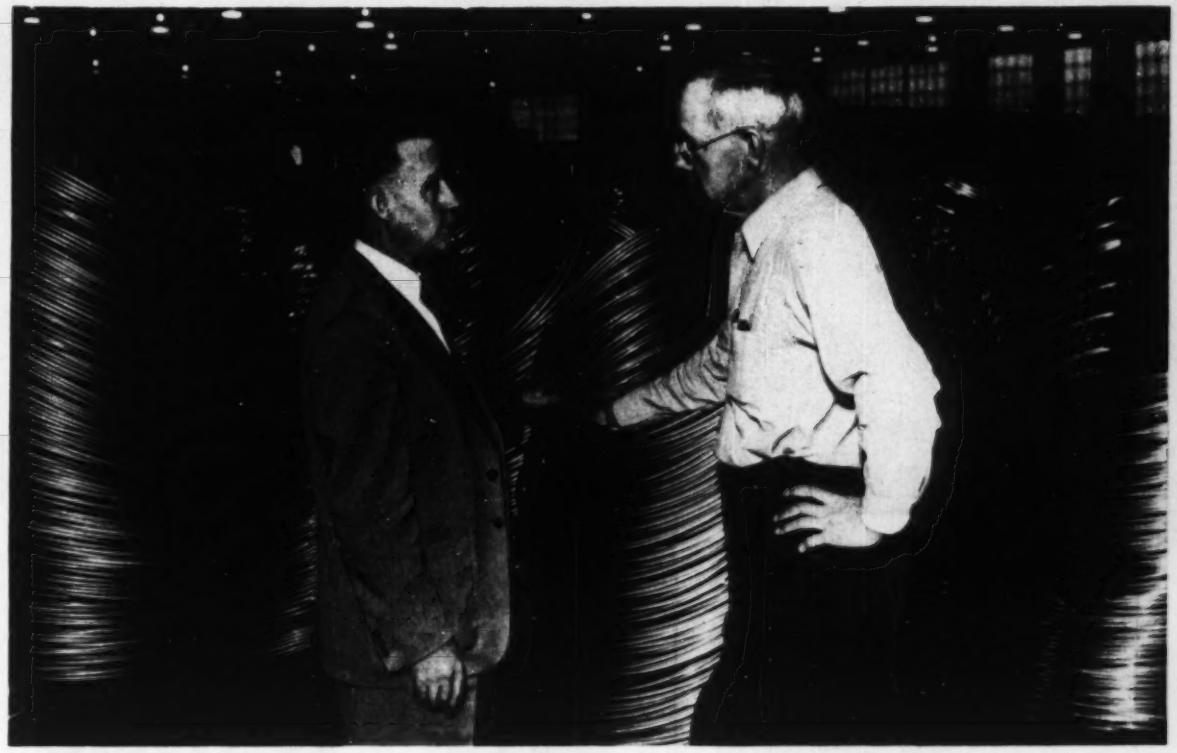
Sirocco Induced Draft Fan

American Blower Fans are used extensively for forced and induced draft, ventilating, air conditioning, drying, fume removal, and processing systems. Write to us for Literature on our complete line of products.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN • CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of American Radiator & Standard Sanitary Corporation

YOUR BEST BUY AMERICAN BLOWER AIR HANDLING EQUIPMENT

Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS



There IS a difference in tubing ...Tubemanship IS that difference!

"Tubemanship?

"Well, sir, I've probably got a different slant on Tubemanship than you have. To me, it means skill and experience. After all, I've been with Wolverine for 34 years. And I've learned a lot! I've found how people recognize a good job. Customers, for example, keep coming back and that means steady work for me and the boys.

"Now you probably have a different angle on Tubemanship than I have. You see it from upstairs."

"That's right, Jim. I do see it from 'upstairs'. I know how we're moving ahead in new developments. How we're always ready to investigate new and better ways of doing things. That's how we came up with Wolverine Trufin* and the Spun End Process.† They're exclusive with us and they represent the type of thinking that keeps Wolverine right out in front of the entire tubing industry!

"And then, there's inspection and quality control from ore or steel strip to finished product. I guess you can say that Tubemanship combines a lot of things—skill, experience, research, equipment, quality control and a knowledge of the tube market."

What Does It Mean to You? Tubemanship means satisfaction—knowledge that when you invest in a Wolverine tubular product—of copper, aluminum or electric-welded steel—it will do its job day after day—year after year. Remember: there IS a difference in tubing—and Tubemanship IS that difference!

WOLVERINE TUBE DIVISION of Calumet & Hecla, Inc., 1483 Central Ave., Detroit 9, Michigan.

*REG. U.S. PAT. OFF. †A PATENTED PROCESS RE. 22455

Wolverine Trufin and the Wolverine Spun End Process available in Canada through the Unifin Tube Co., London, Ontario.

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EST. 1915

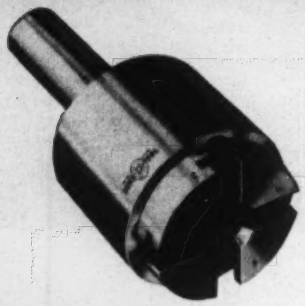
WOLVERINE TUBE DIVISION
OF CALUMET & HECLA, INC.
Manufacturers of Quality-Controlled Tubing

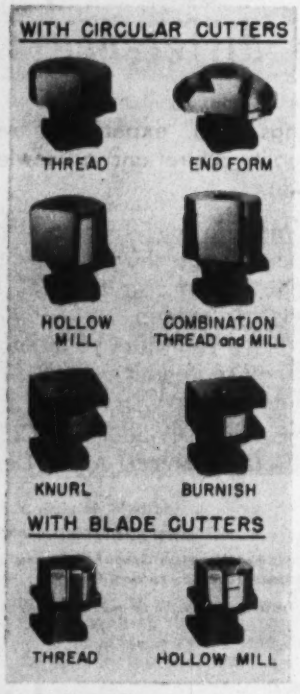
PLANTS IN DETROIT, MICHIGAN, AND DECATUR, ALABAMA. SALES OFFICES IN PRINCIPAL CITIES.

Export Dept., 13 E. 40th St., New York 16, N.Y.

knurled...

78% faster





WITH VERS-O-TOOL

When Whitin Machine Works, Whitinsville, Mass., applied their 1⅝" standard Vers-o-tool to one-pass knurling this textile machine part (7" long, B-1113 steel), they stepped up former production from 72 to 128 pieces per hour.

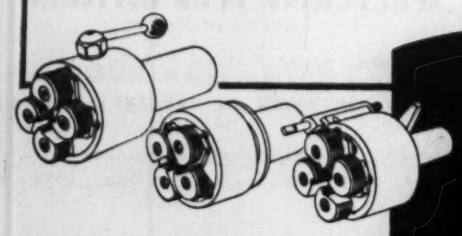
They get a higher quality too, because the 4-cutter Vers-o-tool head opens instantly at the end of the cut and pulls back fast without contact to damage the sharp knurl. Thousands of different jobs are run every day with standard Vers-o-tools equipped with multiple chasers or cutters such as those shown at the left.

Most of these simple, rugged heads are used for threading, equipped with the long lived Ground Thread Circular Chasers—most economical for long runs—or with the lower-cost Adjustable Blade Ground Thread Chasers for smaller lots. All guarantee Class 3 or pressure-tight quality threads—and smoother.

Conversion from Circular Chaser threading to any other type multiple cutters is simple: you change only the cutters and blocks—all types of which are interchangeable, head size for head size, for revolving or non-revolving heads. Vers-o-tool capacities range from .056" to 6½".

Ask us to show you how standard VERS-O-TOOLS can step up your OUTPUT, guarantee ACCURACY, reduce your TOOL INVESTMENT and your OPERATING COST. Ask for catalog DT-52.

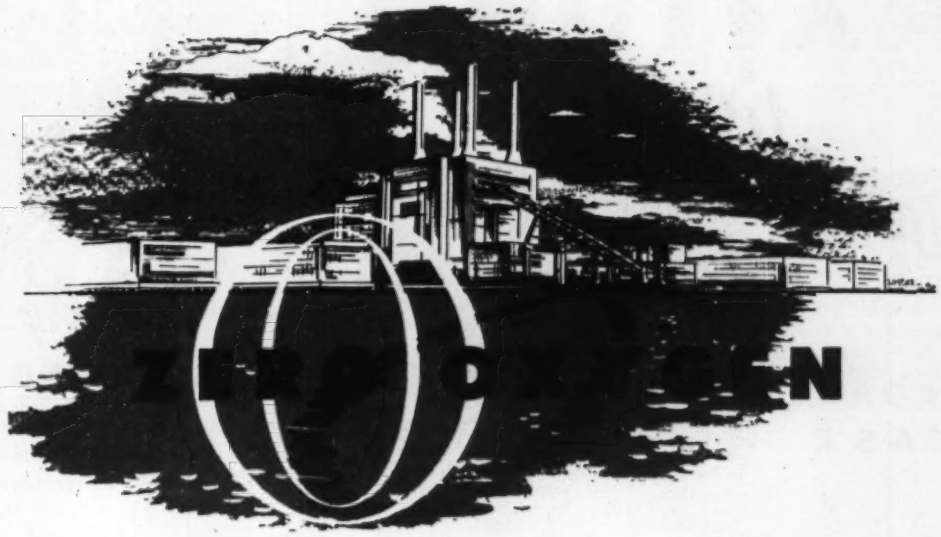
24-hour deliveries on standard stockable NC and NF chasers and blocks. Also National Taper Pipe and Dry Seal.



The NATIONAL ACME COMPANY

170 EAST 131st STREET • CLEVELAND 8, OHIO

ACME-GRIDLEY BAR and CHUCKING AUTOMATICS
1-4-6 and 8 Spindle • Hydraulic Thread Rolling Machines • Automatic Threading Dies and Taps • Limit, Motor Starter and Control Station Switches • Solenoids • Contract Manufacturing.



DEAERATING EFFICIENCY

less than seven parts per billion guaranteed

These are words. What you want is *PERFORMANCE.* Cochrane's unparalleled experience in years and number of installations with all types of deaerating equipment assures you that *guarantees will be met!* Check this statement with any Cochrane user.

Cochrane has the greatest number of deaerating heater installations of any manufacturer in the world. Manufacturing every type of deaerating heater and water conditioning equipment, Cochrane's *complete* service assures you unbiased recommendations for equipment to performance specifications. It assures undivided responsibility for engineering, fabrication and satisfactory continuing operation by a single company.

For further information on Cochrane Deaerators, write for Publication Nos. 3005, 4643 and 4635.

Other Cochrane Processes

DEMINERALIZER

Cochrane ion exchange units deliver a continuous supply of demineralized silica-free water at extremely low cost. Pub. No. 5800.

HOT ZEOLITE

Replaces second stage phosphate treatment in hot-process softener. High temperature ion exchange resins completely remove residual hardness at great savings in soda ash and phosphate. Pub. No. 4801.

SOLIDS CONTACT REACTOR

Slurry blanket principle efficiently removes solids, turbidity, color, taste, silica, fluorides, and reduces alkalinity from water for industrial and municipal purposes. Pub. No. 5001-A.

COCHRANE CORPORATION · WATER ENGINEERS FOR 91 YEARS · 1863 - 1954

Cochrane

CORPORATION

3142 17th STREET, PHILADELPHIA 32, PA.

Representatives in 30 principal cities in U. S.; Toronto, Canada; Mexico City, Mexico; Paris, France; Havana, Cuba; Caracas, Venezuela; San Juan, Puerto Rico; Honolulu, Hawaii.

Pottstown Metal Products Division—Custom built carbon steel and alloy products

COCHRANE CORPORATION
3142 NO. 17TH ST., PHILA. 32, PA.

Send me a copy of Publication Nos. 3005, 4643, 4635, 5800, 4801, 5001-A. (Circle publication desired).

Name_____ Title_____

Company_____

Address_____

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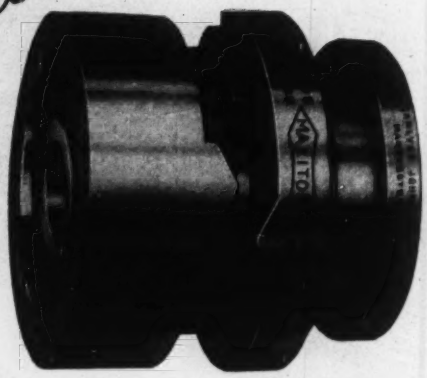
Demineralizers • Hot Process Softeners • Hot Zeolite Softeners • Dealkalizers • Reactors • Deaerators • Continuous Blow-Off • C-B Systems • Specialties

MAXITORQ

automatic



OVERLOAD RELEASE

CLUTCH

To designers and manufacturers of high-speed automatic machinery, Carlyle Johnson offers practical engineering recommendations for applications of this protective power transmission unit.

Let's consider, for instance, a can or bottle labeling machine . . . when an accidental overload shock occurs. Labels go flying all over the place, cans or bottles gang up and are dented or broken, the driving mechanism is jammed . . . and all that costs money and down-time.

But not if your original power transmission is controlled by the Maxitorq automatic Overload Release Clutch, which is manually adjusted to transmit the normal running load and instantly disengages into neutral when the overload strikes. With a minimum of clean-up, the clutch is re-engaged . . . and all is well.

Overload Release Cups (note the cam construction) are the means by which the clutch is connected to the driven or driving member. We make them at relatively low cost . . . and can also supply hub, ring, flange, or cut-off coupling types to suit your specific conditions. Clutches standardized in 6 sizes, ¼ to 5 H.P. @ 100 r.p.m.; working torque, 13 to 263 ft. lbs.

Send for Bulletin ME-105-5

THE CARLYLE JOHNSON MACHINE CO.

MANCHESTER . . . . . CONNECTICUT

Frankly

SPEAKING

There are quite a few types of clutches but, within its capacity, the Maxitorq Floating Disc Clutch is not excelled in applications for which it is intended. The Carlyle Johnson Machine Company is celebrating its 50th anniversary of clutch manufacture. Throughout those years, our engineers have developed new design features, more and more compact construction, improved wearing qualities, and better machining practices for maintaining reasonable costs.

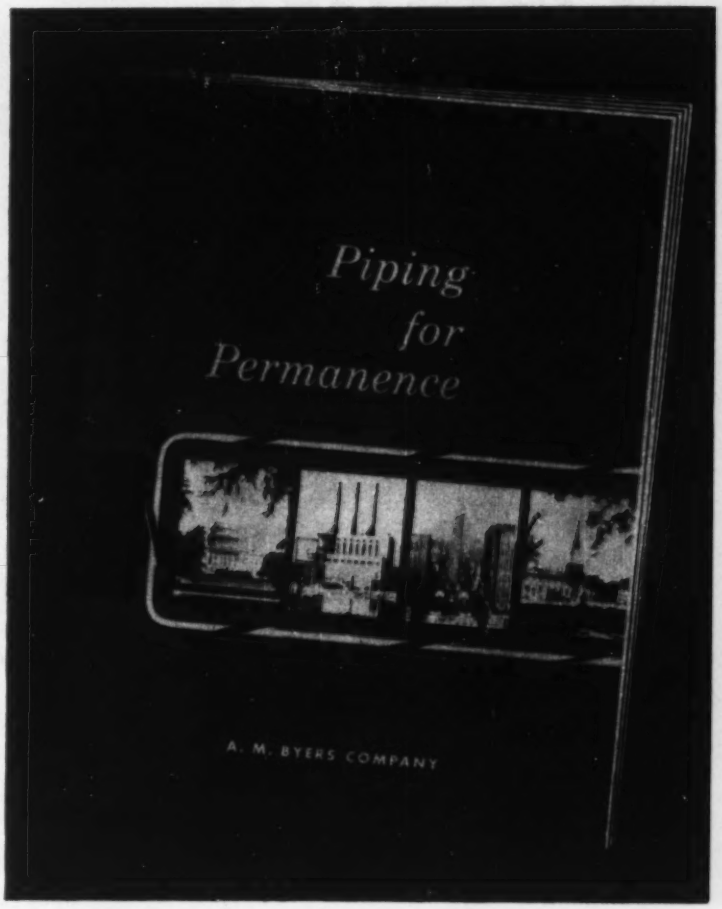
Perhaps the outstanding design feature is the patented "Separator Springs," a definite improvement that moved multiple disc clutches up to the front line. Used between each pair of inner discs, they spread them endways with an accordion action, so that light may be seen between all discs when the clutch is in neutral. Therefore, there is no drag, no abrasion, no heating. The discs actually "float" or ride free when the clutch is in the neutral position.

Carlyle Johnson's method of finishing the engaging faces of the discs assures flat, true surfaces. This means that under engagement there are no high or low spots . . . the entire area of the surfaces has an evenly distributed contact. Obviously, disc service life is greatly extended. Such refinements are the result of continuous study by our engineers to make and keep the Maxitorq name high on the list of machine and product designers for their original equipment for control of power transmission.

Your problems are in good hands if you put them up to our engineers for solution. We've traveled the country over to check on the best and most practical installations . . . and we're on call whenever a problem arises. Just ask for Frank R. Simon, The Carlyle Johnson Machine Company, Manchester, Conn.

Your copy is ready

...PIPING FOR PERMANENCE



The nature of piping problems in heating and plumbing systems, and the methods by which they can be solved, are discussed in detail in this 32-page Bulletin.

Prepared by our Engineering Service Department, this Bulletin is based on the information we have gathered from analysing complete data on thousands of piping installations of every type, under all kinds of conditions. This pool of experience has been condensed between covers in a clear, easily followed story to help you realize greater piping economy in your installations.

The bulletin also includes a roundup of wrought iron pipe installations from every part of the country and presents practical evidence of the results obtained from the use of the material. These past service records are providing leading engineers everywhere with a practical guide for today's selection.

Your copy is ready. Write for it today.

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. Export Dept.: New York, N.Y.

You'll find information on:

Requisites of a piping system—brief review of piping material properties essential to long-life, economical service.

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BYERS

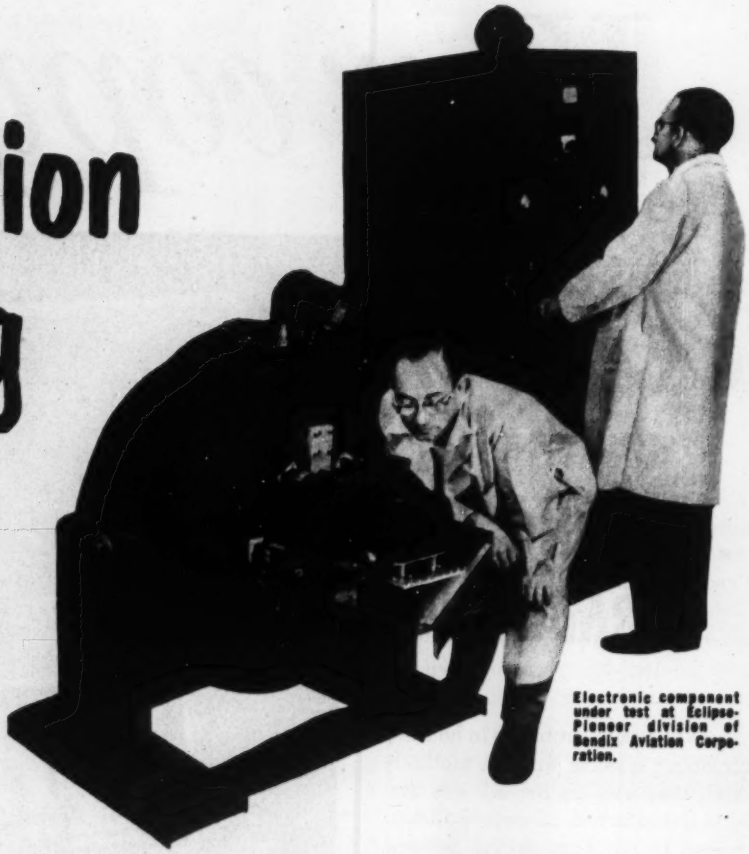
CORROSION COSTS YOU MORE THAN WROUGHT IRON

WROUGHT IRON

TUBULAR AND HOT ROLLED PRODUCTS

ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS

Vibration testing made easier



Electronic component under test at Eclipse-Pioneer division of Bendix Aviation Corporation.

with the help of MB equipment like this

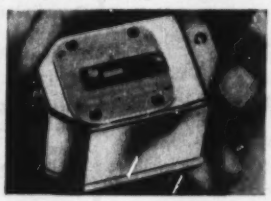
Do you have to vibration-test your product to meet military specifications? Want to apply shake-testing to improve product design or to control quality? If so, do what many leading companies have done—enlist the help of MB.

First, you get the right equipment. MB offers a *complete* line of vibration exciters from 10 pounds force all the way to the largest developed today—10,000 pounds! All are quality built to stand up and do the job right to specifications. Electromagnetic in operation, they're easily and quickly adjusted for force and frequency. And, second, you get the benefit of MB's wide experience in applying this relatively new and valuable technique for product improvement.

Among the well known companies working with MB products, Bendix Aviation Corporation's Eclipse-Pioneer division is outstandingly equipped with *several* MB Vibration Exciters. The photograph shows one—MB Model C-25, rated at 2500 pounds of force—vibrating an electronic component to insure dependability under severest conditions. Such testing can uncover, in minutes, trouble that might take months to develop.

VIBRATION PICKUP ANOTHER USEFUL TESTING TOOL

When you want to detect vibration and determine its nature, you'll want an MB Vibration Pickup. While the pickup detects even slightest vibratory motion, it was built for grueling service as well. Model 122 withstands temperatures up to 500°F.



Control panels for all MB shakers, as in the photo above, can be furnished with MB Vibration Meter for use with pickup. This meter gives direct velocity, acceleration and amplitudes of the picked-up vibration.

Bulletins you'll welcome

How to calibrate vibration pickups to 2000 cps—Bulletin C-11-4 reviews the subject comprehensively. Bulletin 1-VE-4 tells all about MB Vibration Exciters. Write for them.

THE MB MANUFACTURING COMPANY, INC.
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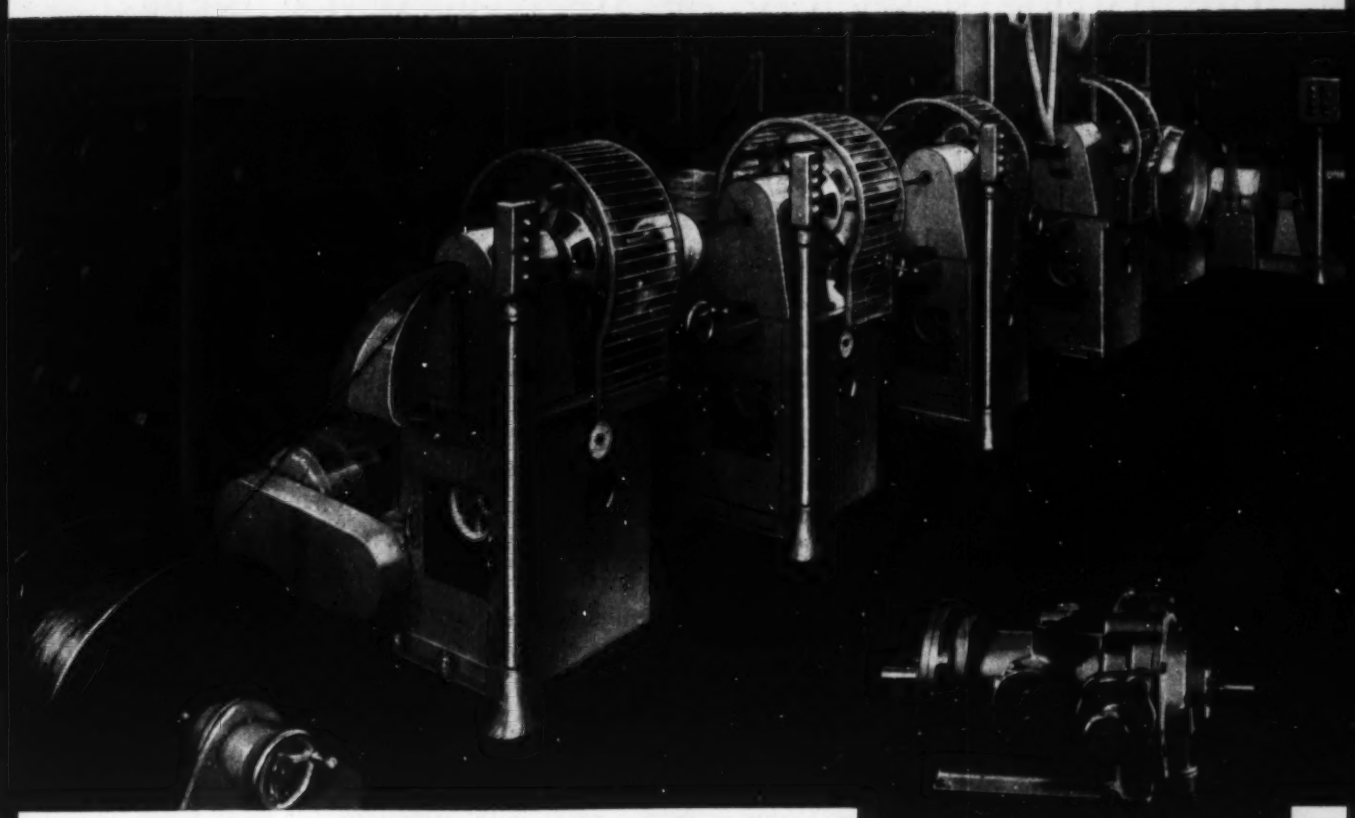
HEADQUARTERS FOR PRODUCTS TO INDUCE VIBRATION...TO MEASURE IT...TO ISOLATE IT

MACHINE DESIGN AT WESTERN ELECTRIC



Its use of Oilgear Fluid Power

Western Electric Company, manufacturing unit of the Bell Telephone System, originates, designs and builds many of the special machines it uses in its own manufacturing processes. It also maintains unceasing pressure to improve upon machines already in operation, for optimum performance, for better product, for lower costs, for freedom from trouble.

Its use of Oilgear Fluid Power Drives and Transmissions has been increasing because, in the words of their engineers, Oilgear enables them among other things to synchronize many machine components easily and economically. A good example of all these points is the "short haul" video cable wrapping machine pictured above.

This machine was designed and built by the company's own men some years ago. For optimum performance, the speed of the heads should be easily and independently variable and the direction of rotation instantly changeable because the lay and pitch of the wrappings must be varied according to the requirements of the run. Moreover, the inside contour of the tube formed by the wrapping should be smooth and uniform so as to avoid setting up echo waves that interfere with transmission and vitiate signal strength.

Because of these requirements, a new drive was installed something over 4 years ago. A line shaft drives five Oilgear Fluid Power Transmissions, one at each machine head and the capstan.

The results were these: uniformity and control of tension are so good, the machine runs at 4 times its former machine speed; it is easy to vary speed and direction of rotation of each individual head; eccentric heads gave way to concentric heads, and supply spools are now loaded to full capacity instead of ¼th to ⅛th as before; the machine is stopped less frequently for loading. Maintenance on the former drive was involved and frequent—on the Oilgear equipment it has been simple and negligible.

There is some reason to suspect that Oilgear Fluid Power with its wide range of advantages may solve some of *your* machine design problems and make the results very pleasing and profitable. Why don't you really find out? THE OILGEAR COMPANY, 1570 West Pierce Street, Milwaukee 4, Wisconsin.

OILGEAR

OILGEAR

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THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Members of the ASME are invited to name any number of engineers as candidates for membership. Engineering acquaintances should be qualified by both fundamental training and experience for one of the technical grades. Those who do not have an engineering degree may show the equivalent thereof through actual practice. Executives of attainment in science or industry may associate with the Society as Affiliates.

THE American Society of Mechanical Engineers promotes Mechanical Engineering and the allied arts and sciences, encourages original research, fosters engineering education, advances the standards of engineering, promotes the intercourse of engineers among themselves and with allied technologists; separately and in cooperation with other engineering and technical societies, and works to broaden the usefulness of the engineering profession.

As a post graduate school of engineering, the Society brings engineers into contact with each other, with leaders of thought and with new developments; it fosters the interchange of ideas, develops professional fellowships, and encourages a high standard of professional conduct—all with the purpose of advancing civilization and increasing the well-being of mankind.

C. E. Davies, Secretary
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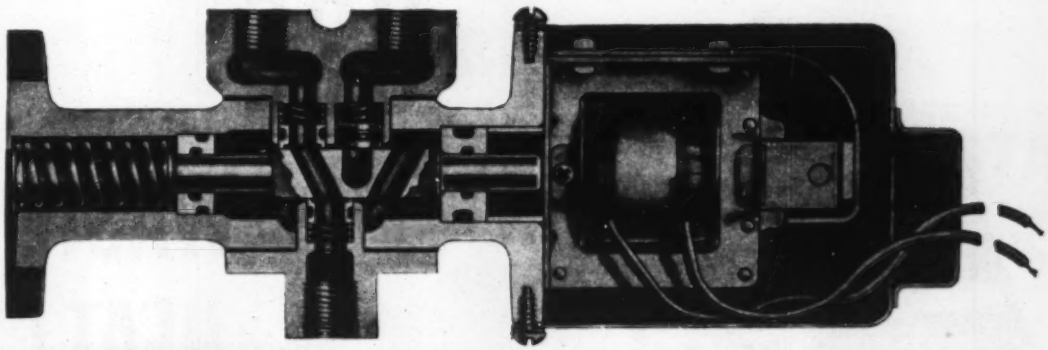

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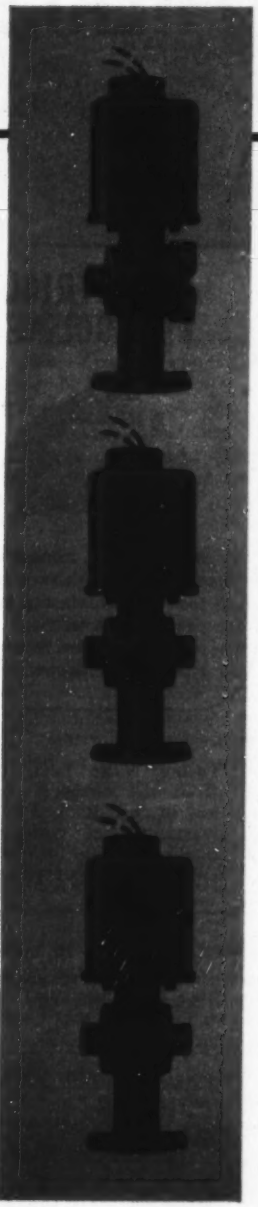

FOUR-WAY

THREE-WAY

SHUT-OFF

Competitive in every respect! The patented "Shear-Seal" principle, that has changed the concepts of extreme pressure control, is now available in this popular edition.

If solenoid valves are among the components of your product, and it needs a sales point in place of a trouble spot, you should get complete data on Barksdale "Shear-Seal" Valves.

Leakproof closure is retained for unbelievably long periods without maintenance, because "Shear-Seals" improve with the lapping action of each valve operation.

Dirt or foreign matter can't harm the sealing quality, because the sealing surfaces remain in constant intimate contact, even during actuation, and flow is through the "Shear-Seal", never across sealing surfaces.

Long trouble free solenoid and valve performance are the end result of the many inherent "Shear-Seal" advantages, well worth your careful consideration.

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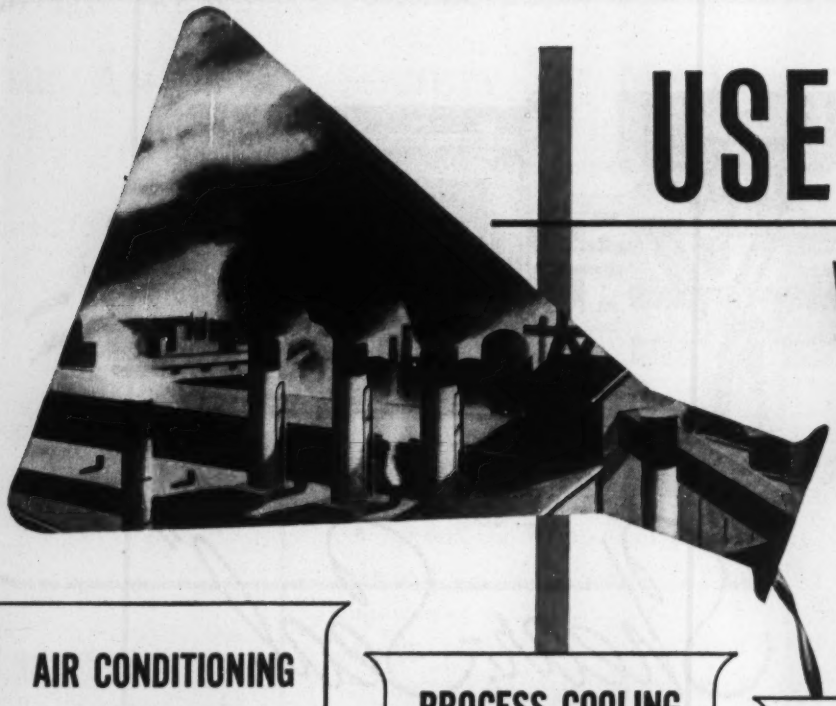
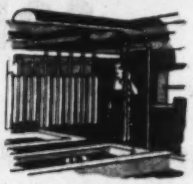


AIR CONDITIONING

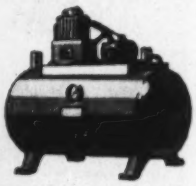
Let the adaptable Servel 25-ton Water Chiller convert waste heat, or steam from any source, into lowest cost air conditioning for your plant and offices!

PROCESS COOLING

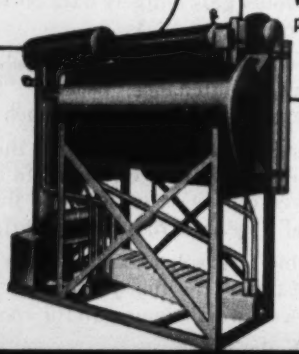


Use the cheapest energy source —even waste heat—to achieve high-efficiency cooling for manufacturing processes! Servel Water Chiller operates on dependable absorption principle.

INDUSTRIAL PRECOOLING



Increase capacity and improve performance of air compressors and internal combustion machines! The Water Chiller is compact, light; can be safely installed on almost any floor.



The Servel Water Chiller cooling system has no moving parts to wear. It is quiet and vibration-free. Light floor loading and freedom from vibration mean that no special foundations or braces are needed. Zone control is unusually easy. And operation (using waste heat, or steam from the cheapest source) is low in cost. Backed by a 5-year warranty. See your dealer or mail coupon for information and engineering co-operation.

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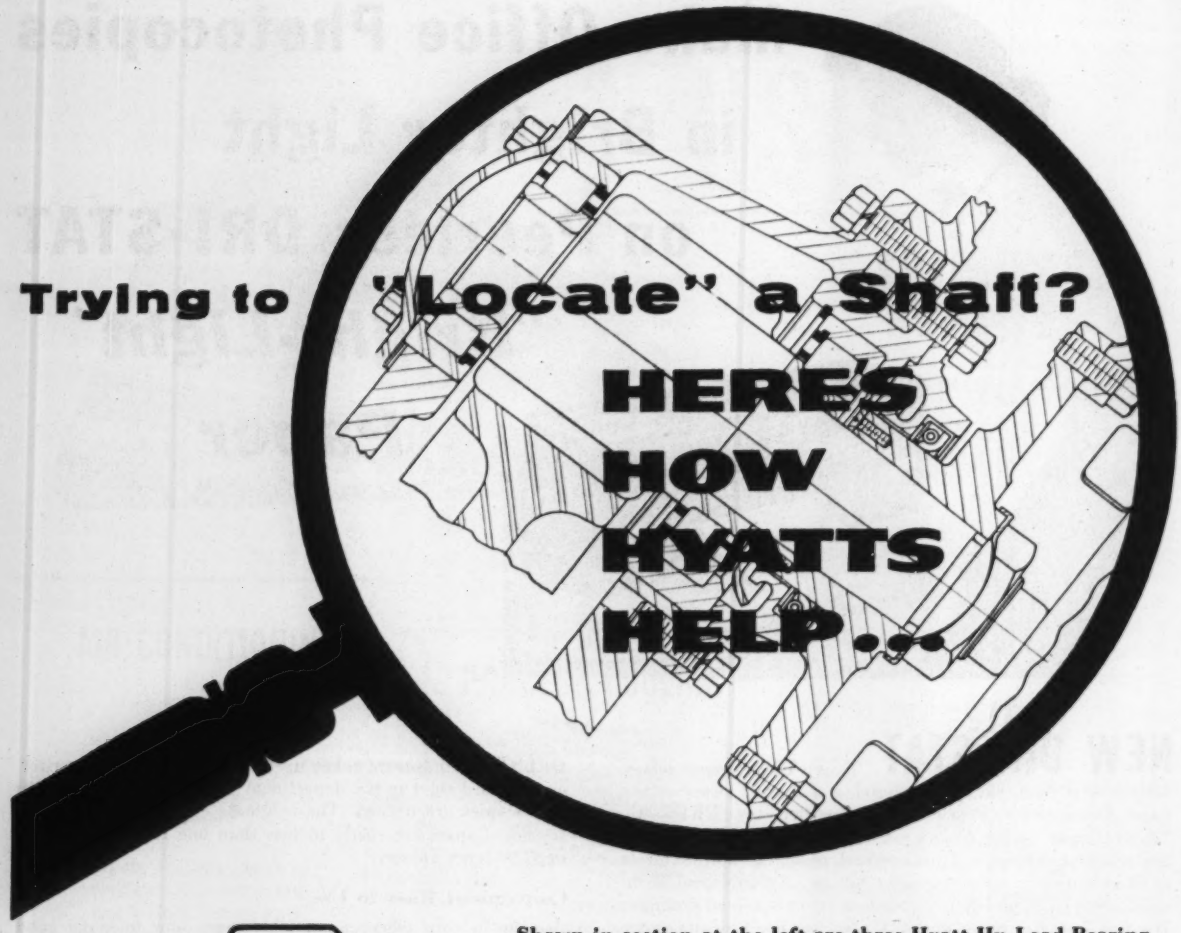
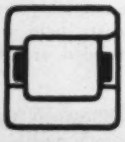
Trying to "Locate" a Shaft?



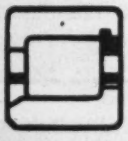
HERE'S HOW HYATTS HELP...

3 TYPES



BU-L
separable outer race series

R-WB
separable inner race series



R-YS
separable inner race series

Shown in section at the left are three Hyatt Hy-Load Bearing types that are used for axial shaft location. Flanges on inner or outer races limit axial shaft movement and permit the bearing to take light, intermittent thrust loads.

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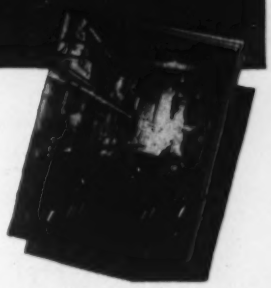

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On the Evaluation of the Accuracy of the Coefficient of Discharge in the Basic Flow-Measurement Equation—A. L. Jorissen

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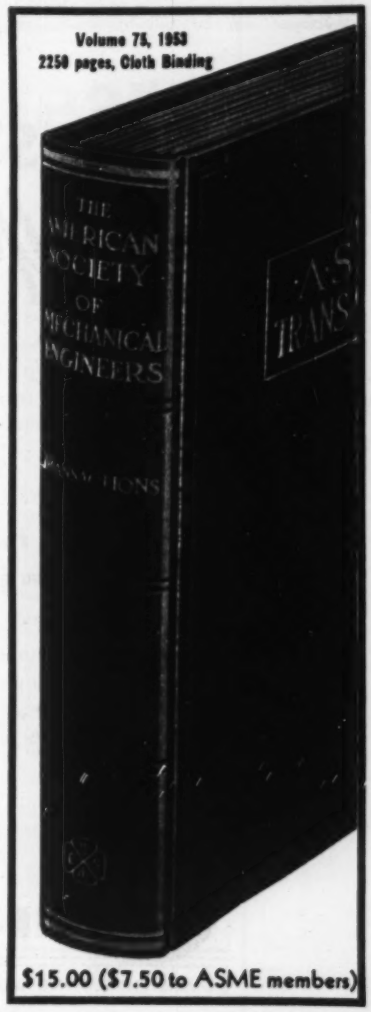

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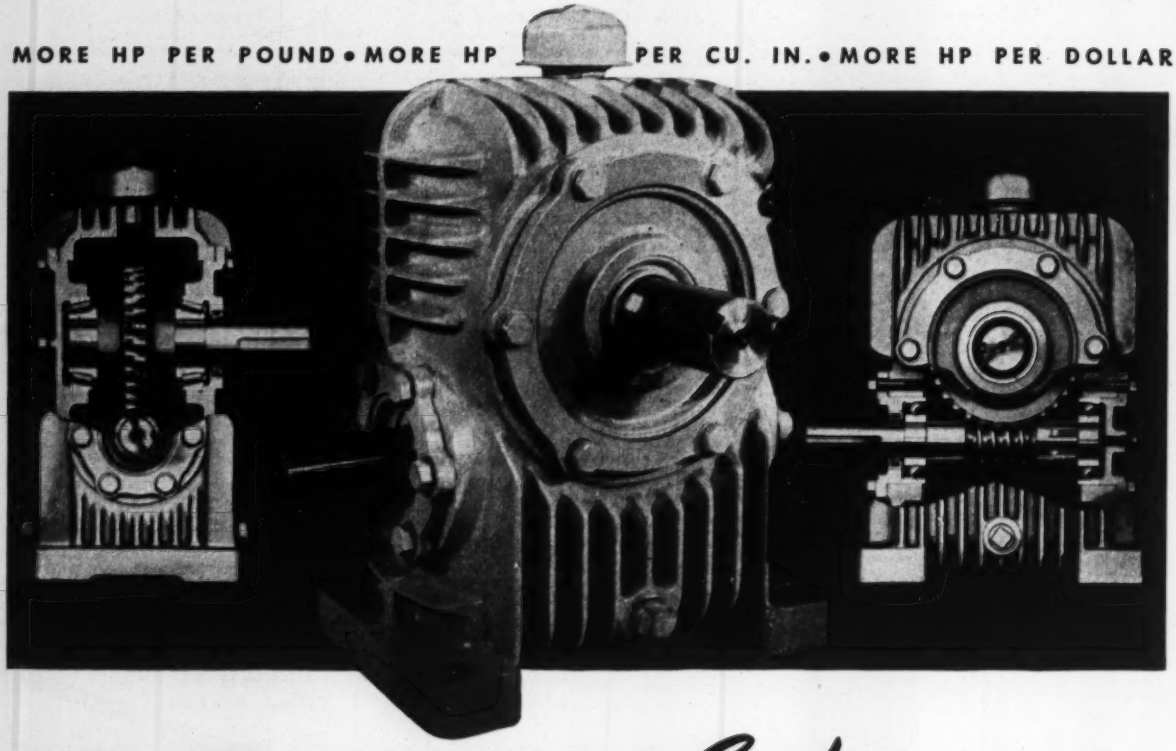

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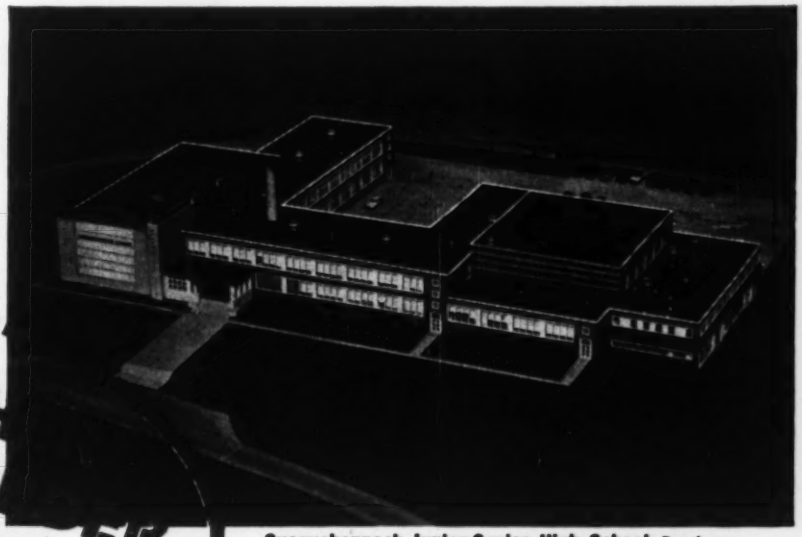

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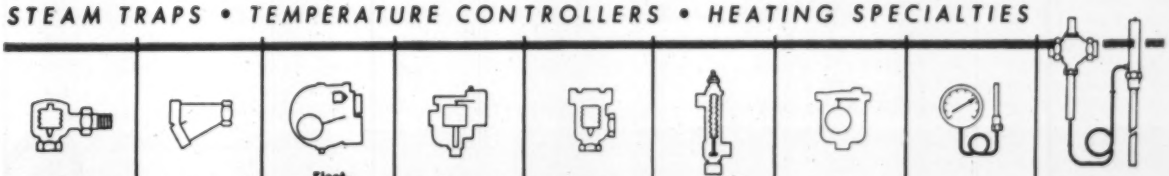

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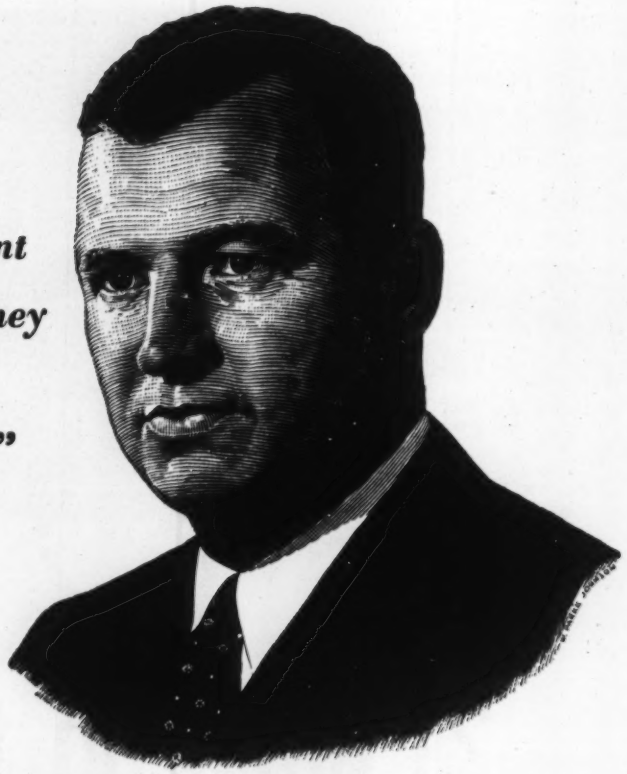

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• At the end of 1953, the cash value of Series E and H Bonds *held* by individuals was more than 36 billion dollars. This total is growing steadily, thanks largely to the month after month purchases of Series E Bonds by more than 8,000,000 Payroll Savers.

• Sales of E and H Bonds in 1953—23% higher than in 1952—provided cash for *all* E and H Bond maturities and redemptions and still left over $210,000,000 *net* for the reduction of bank-held debt.

• The ownership of more than $36,000,000,000 in Savings Bonds by millions of Americans constitutes a reservoir of future purchasing power—an asset to industry and business as well as to the individuals who built it by their Bond-conscious thrift.

Why not team up with Mr. Peale and other leaders of industry in their efforts to help America reach its goal of wise public debt management and sound money? All you have to do is (1) show a *personal* interest in your Payroll Savings Plan. Get the figures on the percentage of employee participation and the amount of monthly savings by your employees. (2) Wire, phone or write to Savings Bond Division, U. S. Treasury Department, Washington, D. C. You'll get all the help you need to build up or install a Payroll Savings Plan that will reflect your company and its interest in America.

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MECHANICAL ENGINEERING

Keeping Thermal Expansion Under Control

Flexible support for piping in all positions of travel must be provided, if destructive stresses and strains are to be avoided in today's high temperature piping systems.

Heat 100 linear feet of alloy steel pipe to 1000° F, and it will expand 9.1 inches! When this thermal expansion takes place in a piping system, the resultant forces induced, if uncontrolled, can do incalculable harm.

Helical coil springs

The practice of using helical coil springs to allow this thermal expansion to occur is quite general. But the care that goes into the design or selection of flexible supports ofttimes is haphazard. In fact, many specifications covering the support of important high temperature piping will simply say "spring hangers shall be provided". Merely to contend that this may be dangerous is not enough.

Safety of entire system at stake

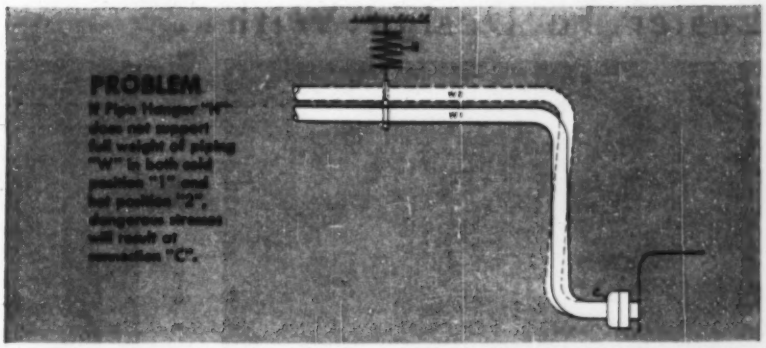
Unless careful study is given to the design and selection of spring supports which will maintain a balanced pipe system, the transfer of weight from one hanger to another, or from a hanger to a terminal point, will endanger the safety factor of the entire system.

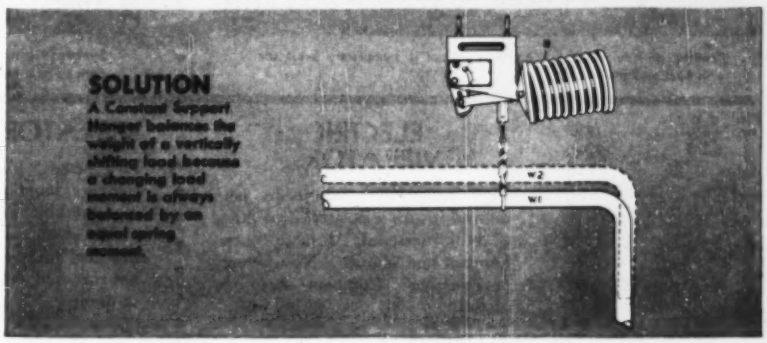
With 8 . . . 9 . . . even 10 inches of thermal deflection not a bit uncommon today, completely flexible support for piping in all positions of travel is a positive "must".

The case for constant-support hangers

Where reactive forces at terminal points in a piping system must be kept within specified limits, constant support type hangers are recommended.

They are designed to provide uniform supporting force equal to the pipe load throughout the travel range and should be used at superheater outlets, turbine connections, and also on high temperature and other critical lines.

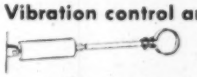

PROBLEM
If Pipe Hanger "A" does not support full weight of piping "W" in both cold position "1" and hot position "2", dangerous stresses will result at connection "C".


SOLUTION
A Constant Support Hanger balances the weight of a vertically shifting load because a changing load moment is always balanced by an equal spring moment.

Variable spring hangers

When pipe lines are subject to vertical movement, and restrictive conditions do not require a constant-support type hanger, variable spring hangers are recommended. They should be designed to support not less than 85%, or more than 120%, of the design load throughout the total travel.

Vibration control and sway brace



When necessary to prevent abnormal movement or vibration in pipe lines, controls or sway braces of the energy-absorbing or instant-acting counter force type, are recommended. They dampen vibration, oppose pipe sway and absorb shock.

Hanger Engineering Service

The Pipe Suspension Department of Grinnell Company offers a design service to engineering firms which appreciate the specialized knowledge required to compute hanger loads and to select the proper supports for a balanced pipe suspension system when high pressures and high temperatures are involved.

Grinnell manufactures a complete line of pipe hangers and supports; maintains an experienced laboratory staff of technicians to discover better ways of solving pipe suspension problems; provides engineering assistance in design and installation; offers stocks of pipe hangers close to any job.

Hanger load calculation booklet

A 28-page booklet entitled "Hanger Load Calculations", compiled to furnish necessary data and procedure to determine pipe hanger loads, can be obtained from Grinnell Company. The tabulations of piping weights and thermal expansion have been arranged for convenient selection of data that otherwise consume considerable time to develop. It's yours without obligation.

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Kindly send me a complimentary copy of your "Hanger Load Calculations" booklet.

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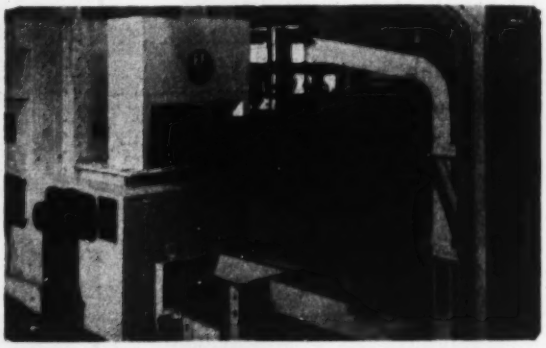
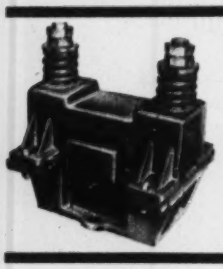


Syntron Vibratory Feeder delivers continuous, controlled flow of metal parts to heat treating furnace.



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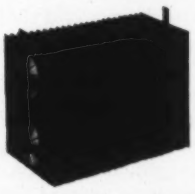

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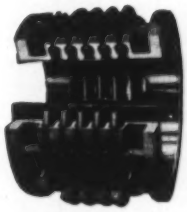

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WITH

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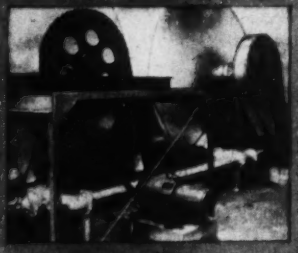
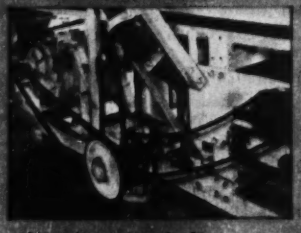
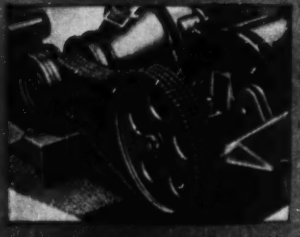


Here is a drive where shaft centers are far apart.



Here is a one shaft to several shafts Diamond Roller Chain application.



An example of widely used internal combustion engine to worm shaft drive.

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◆

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◆

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There is no right or wrong side.

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Obstructions can be by-passed economically.

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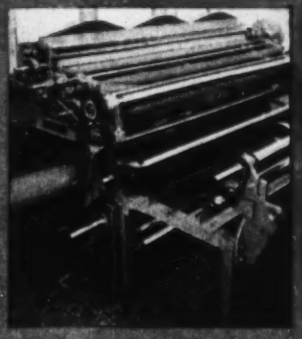
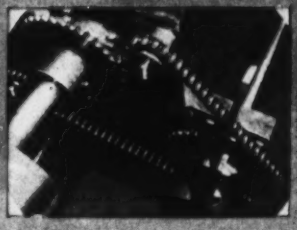
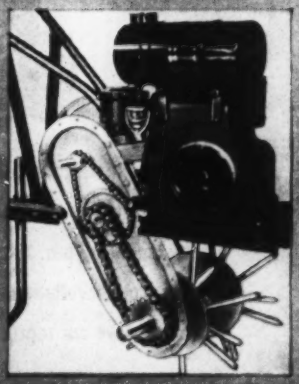


What other means could be used than shown by this Diamond Roller Chain application?



A simple means of operating two shafts in opposite directions.



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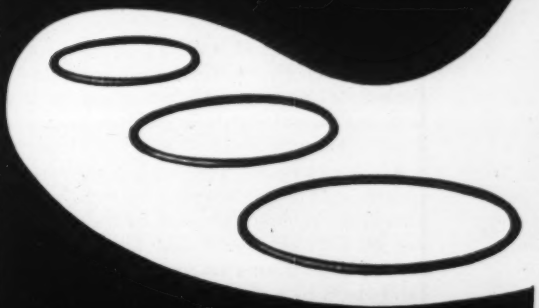

Available from Linear is a wide variety of high quality, precision moulded "O" rings for industrial applications . . . also "O" rings to meet the latest government requirements, such as AN or MS types to MIL-P-5516, MIL-G-5510, MIL-P-5315 requirements.

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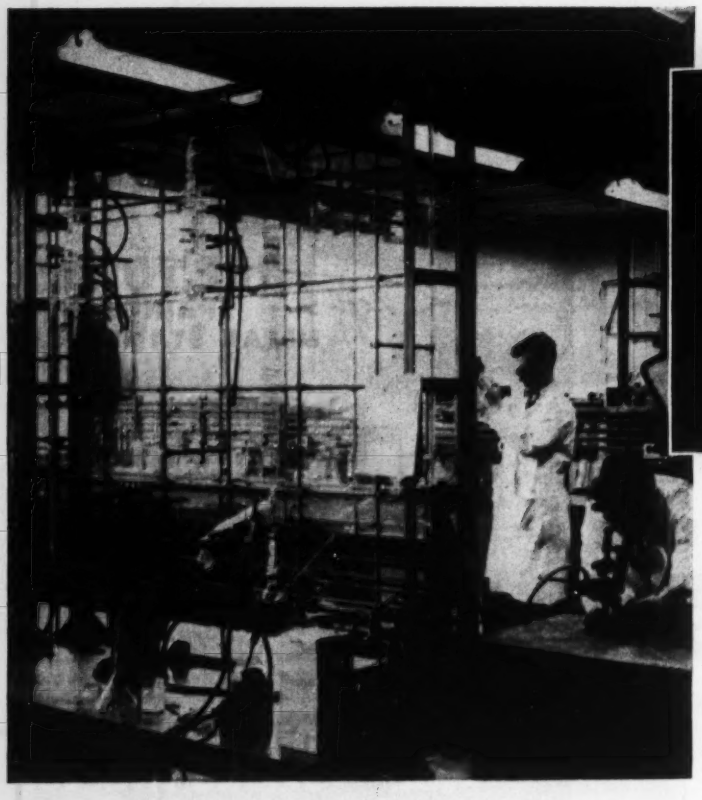

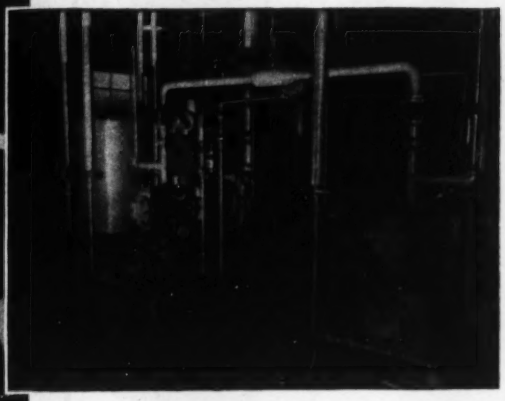

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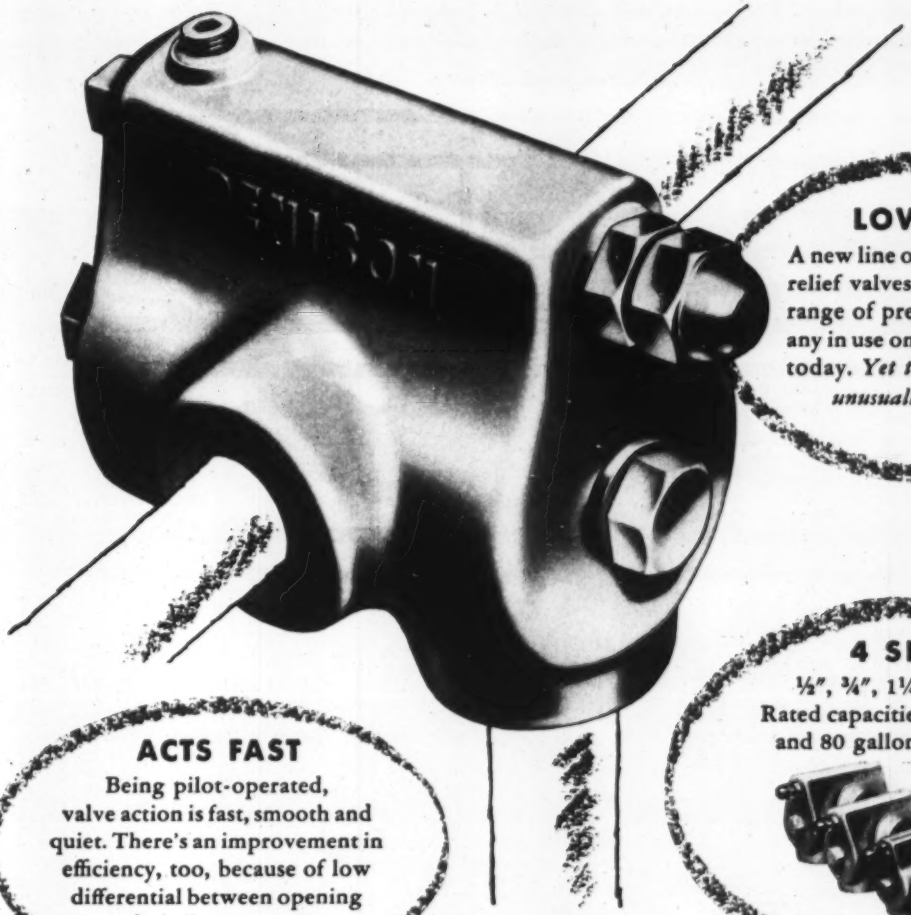

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It is by taking care of our own that we also make America strong. For the strength of our country is simply the strength of each secure home joined to the security of another.

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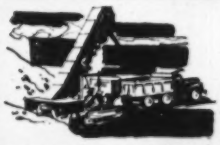

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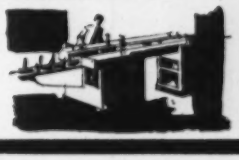

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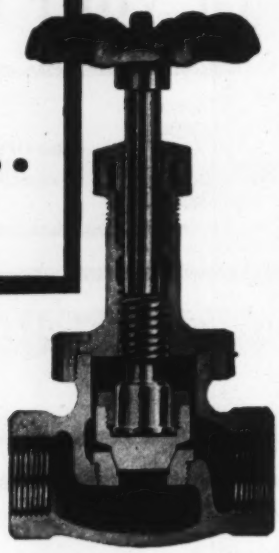
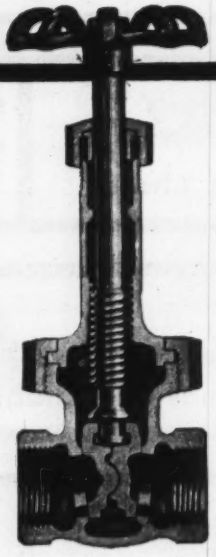
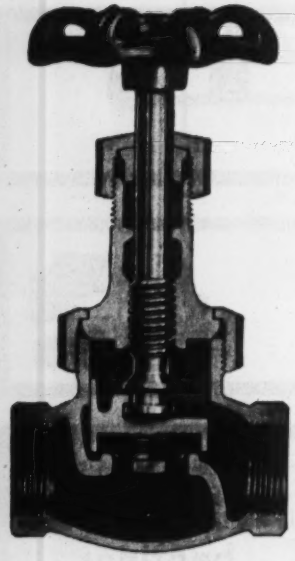
Walworth bronze valves...



Walworth No. 225P Globe Valve
500 Brinell Seat and Disc



Walworth
No. 29 Gate Valve



Walworth No. 95 Globe Valve
Re-New-Disc

built to give dependable trouble-free service on all recommended jobs

Walworth No. 95 Bronze Globe Valves (Angle Type: No. 96) are recommended for service where throttling is not required. They are rated at 150 psi working steam pressure, 500F; 300 psi cold water, oil or gas. The improved renewable disc and lock-on, slip-off disc holder — an original Walworth development—saves time and trouble. This valve can be repacked under pressure when fully opened. All parts are designed to give maximum service and strength.

Walworth No. 29 Bronze Gate Valves are rated at 200 psi working steam pressure, 550F; 400 psi cold water, oil and gas. These valves have rising stems and integral seats. Sizes 2-inch and smaller have union bonnets; sizes 2½ and 3-inch have bolted bonnets. Valves up to and including ¾-inch have solid wedge discs; 1-inch and larger have split wedge discs. These valves can be repacked under pressure when fully opened.

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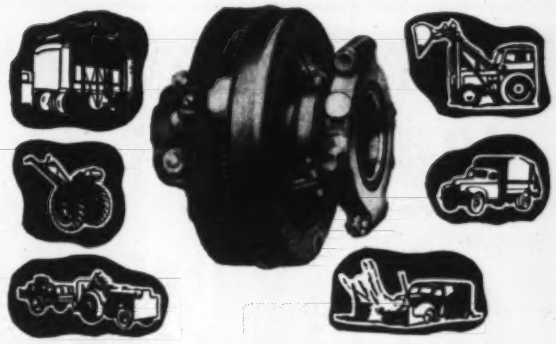

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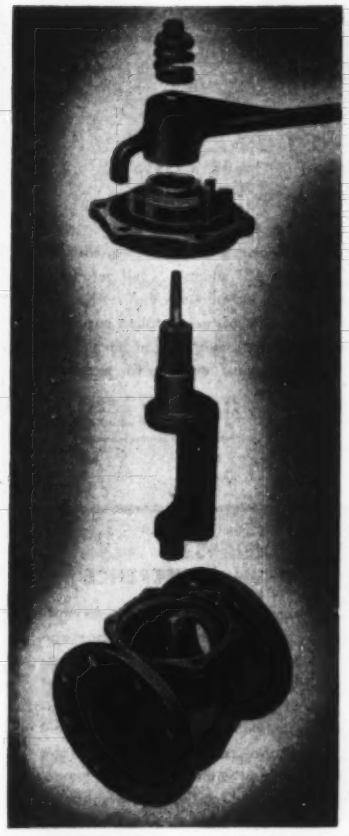

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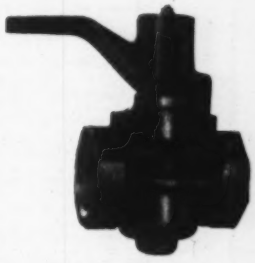

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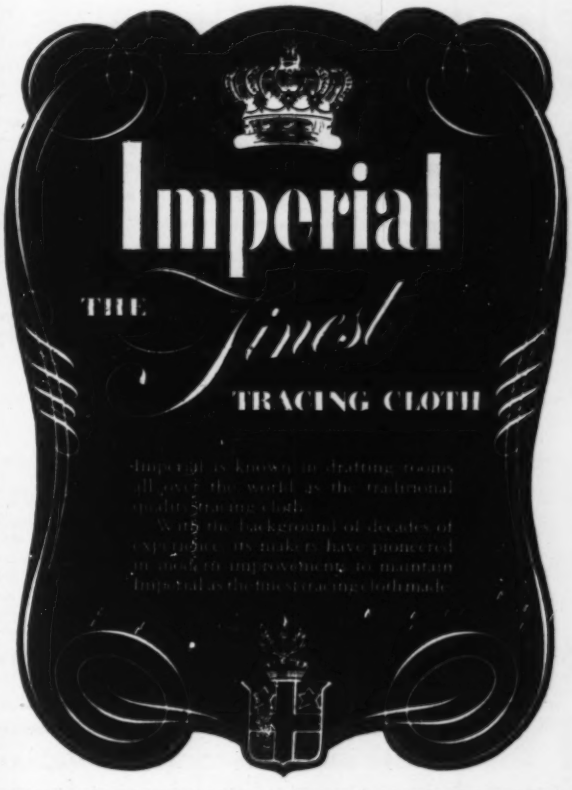

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Published January 1954 **$2.50**

PROCEEDINGS OF THE 1953 OIL AND GAS POWER DIVISION CONFERENCE

The thirteen contributions in this book contain a great deal of practical information on a variety of subjects. Specifically, on cast ferrous metals, package units for utilizing waste heat energy, valve gear fundamentals, flame temperatures in a single cylinder spark ignition engine, two and four cycle results of medium speed engines on heavy fuels, residual fuel oil production and utilization, crankwebs, tuned manifold, supercharging without a blower, diesel plant design, crankcase explosions, diesel maintenance control by spectrographic means, diesel lubricating oil performance as related to the electron microscope, and combustion of a low-volatility fuel in a turbo-jet combustion chamber.

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Viscosity of Lubricants Under Pressure

This new publication reviews and coordinates twelve experimental investigations made in England, Germany, Japan, Russia and the United States over a period of thirty-five years. The tests were made on 148 lubricants comprising of 25 fatty oils, 94 petroleum oils, 17 compounded oils and 12 other lubricants. Data are coordinated by means of sixty tables in which the results originally appearing in diversified units are compared. The methods proposed for correlating viscosity-pressure characteristics of oils with properties determined at atmospheric pressures are reviewed and illustrated. Pertinent aspects such as experimental work on heavily loaded bearings, lubrication calculations, and additional techniques for viscosity are covered. Conclusions and recommendations are presented. Other chapters give the required computation of the temperature coefficients of viscosity, method of computing pressure coefficients, a bibliography of 189 items, and symbols used.

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GLOSSARY OF TERMS IN NUCLEAR SCIENCE AND TECHNOLOGY

This standard authority places at your fingertips nearly 2000 nuclear terms and affords you an opportunity to become acquainted with the newly-coined terms used in and outside your own sphere of activity.

Covering the fields of Physics, Reactor Theory, Reactor Engineering, Chemistry, Chemical Engineering, Biophysics and Radiobiology, Instrumentation, Isotopes Separation, and Metallurgy, the Glossary lists and defines the terms peculiar to each of these fields, terms used in them in a different sense or with different emphasis from what is commonly understood in other connections, and those used elsewhere in the same way but so infrequently as to be unfamiliar. An index to all the terms shows at a glance the section in which each term and its definition will be found.

Seventeen scientific and technical societies, ten national government agencies, and four divisions of the National Research Council participated in the compilation of this work.

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This report of the ASTM-ASME Joint Committee on Effect of Temperature on the Properties of Metals, is a graphical summary of the elevated-temperature strength data for the chromium-molybdenum steels. It includes summary curves for tensile strength; 0.2 per cent offset yield strength; per cent elongation and reduction of area; stresses for rupture in 100, 1000, 10,000, and 100,000 hr. and stresses for creep rates of 0.0001 and 0.00001 per cent per hr. The appendix contains data sheets which include chemical composition, processing data, heat treatment, and other pertinent information about steels in the survey; also primary data from which the survey curves were prepared.

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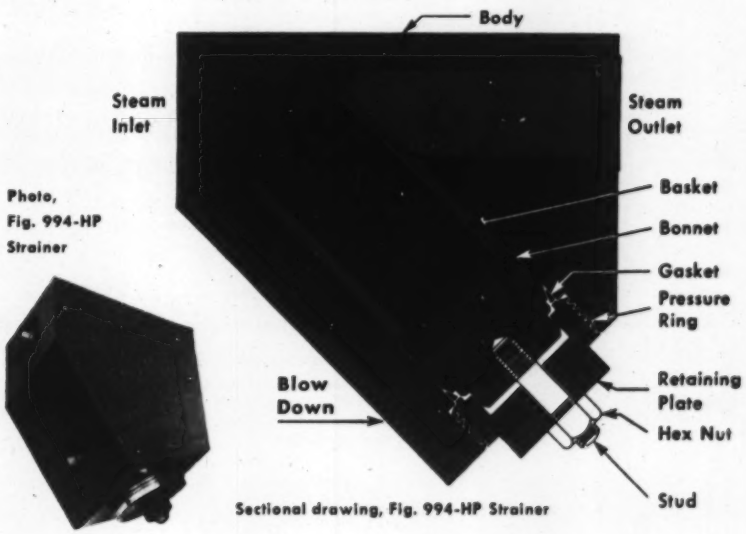
News

NEW STRAINER FOR HIGH PRESSURE STEAM AND BOILER FEED SERVICE FEATURES FORGED BODY AND "PRESSURE SEAL" JOINT*



Photo, Fig. 994-HP Strainer

Sectional drawing, Fig. 994-HP Strainer

After several years of field testing in selected high pressure power plants, SK now announces the general availability of a new "Y" Type Strainer for steam and boiler feed pressures from 900 lbs. up.

The strainer, designated an *SK Fig. 994-HP Strainer*, features a forged steel or alloy body and "pressure seal" bonnet construction. The "pressure seal" joint, see Fig. 994-HP and note above, eliminates the excessive bulkiness of a flanged, bolted cover which, at higher temperatures and pressures, necessitates the use of large studs and nuts and unnecessarily large over-all design. As shown, the "pressure seal" design is compact with minimum face to face dimensions.

The basket is rolled from perforated or drilled plate which, when required, serves as backing for a fine mesh screen. The blow down connection has been brought through the side of the strainer wall. This design feature means that no piping need be broken when removing the cover and strainer basket from the body for maintenance, checking, or replacement. This factor is particularly advantageous at high pressures and temperatures where pipe joints are usually welded.

SK Fig. 994-HP Strainers are made in any size required by the application. For details, request Bulletin Supplement 9S-HP. If you have an immediate problem, write to us at the address at right. A sales engineer will call.

***NOTE:** Schutte and Koerting Company is one of the pioneers in the development of pressure seal joint construction in the United States having first experimented with this design in 1938. As shown in Fig. A (detail drawing of the "pressure seal" gasket) practical experience and research have resulted in a successful design wherein the gasket angle is relatively narrow and the gasket has been completely plated with a metal coating. The sharp gasket angle is of particular importance in small diameter pressure seal joints where the ratio of linear circumferential length of the gasket tip, which must be expanded, to the pressure area of the small diameter cover, is relatively high. The thin metal coating material is of a non-corrosive "lubricating" nature and is satisfactory for high temperature service while being soft enough to deform, under pressure, and fill minute irregularities in the body bore and cover gasket face. The base metal of the ring, under the coating, meets rigid specifications of dead soft anneal and dimensional tolerances. Note, also, that the body counterbore diameter is increased just below the gasket. This eliminates the necessity for drawing the gasket out through a long, close diameter bore and makes disassembly easy.

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YOUNG MECHANICAL ENGINEER—to carry out process development and design of equipment for metal removal. Experience with welding or oxyacetylene cutting preferable but not essential. An excellent opportunity for the right man to grow with a young, aggressive and rapidly expanding firm. Send brief history and starting salary desired with reply. Address CA-4664, care of "Mechanical Engineering."

CONTROL ENGINEERS—Mechanical graduate familiar with design, application, selling, operation or servicing air or electric control systems. Eastern headquarters. Outline experience etc. Address CA-4665, care of "Mechanical Engineering."

ASSISTANT CHIEF ENGINEER—subject to 6 month's trial period, for graduate mechanical engineer, under 30 years of age, having minimum of 15 years' good industrial plant experience. Position entails wide range of engineering work including operation and maintenance of boilers, milling plant, sugar processing equipment and corollary facilities. Large American-owned sugar company operating in Cuba. Good quarters furnished by Company. Salary not subject to U. S. income taxes under present laws. Reply giving complete details, stating age, marital and military status, experience, technical training and salary requirements. Reply will be held confidential. Address CA-4672, care of "Mechanical Engineering."

Additional Opportunities are offered in the display advertisements— on pages 58, 60, 64, 71, 123

MECHANICAL DESIGN ENGINEERS—For plant layout and automatic machine design. Positions entail wide range of engineering work, some electrical. Experience in pulp, paper or wallboard plants desirable but not necessary. Reply giving complete details of experience and training. Opportunities for advancement. Salary to start $5,000–$7,000 depending on age and experience. Location south. Address CA-4671, care of "Mechanical Engineering."

National Concern, with plants in eight cities, desires: GRADUATE MECHANICAL ENGINEER, between 30 and 35 years of age, with some manufacturing experience, preferably in materials handling. Experience in some field of paper converting would be advantageous. Location to be New Orleans, Louisiana. Compensation would be measured to some degree by experience but opportunity to advance would be excellent. Address CA-4674, care of "Mechanical Engineering."

Four Pages of "OPPORTUNITIES" This Month . . . 129-132

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MATHEMATICIANS AND STATISTICIANS
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B.S., M.S., Ph.D., 0–8 years' experience

Send resumé and salary information to
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CARBIDE AND CARBON CHEMICALS COMPANY
a division of
UNION CARBIDE AND CARBON CORPORATION
POST OFFICE BOX P, OAK RIDGE, TENNESSEE

VIBRATION ENGINEER—to design equipment to be used in shock and vibration testing of electronic missile components. Would work closely with electronics engineers to determine means of eliminating the causes of failure of equipment due to shock and vibration. A minimum of four years' experience in dynamic motion is required. Our firm is affiliated with a leading university and offers the stability and atmosphere of an academic situation coupled with the monetary and professional benefits of industry. Location, Western New York. All replies will be considered confidential. Address CA-4678, care of "Mechanical Engineering."

ENGINEERS (Career Opportunity)—Important Aircraft Engine Accessory Manufacturing Company located in Central Connecticut has openings for graduate engineers in their Project Engineering Department. The organization, though small enough to provide diversity and individual recognition of achievement, is large enough for stability. Not only will you have close and constant association with leading engineers, but the opportunity for rapid individual development by contact with all phases of projects. These positions are open for men with—I. a background of servo theory for dynamic analysis of feedbacks control systems, as applied to turbojet and turboprop engines. Will be required to set up and perform system analysis by use of analogue computer equipment. II. a background in fluid mechanics to work on hydraulic control development and fuel systems for turbojet engines. Will be required to execute design and performance analysis for steady state and transient conditions. Ideal surburban location for working and living. Send resumé of education, experience, and salary requirements. All replies will be promptly considered and kept confidential. Address CA-4680, care of "Mechanical Engineering."

TECHNICAL LITERATURE ABSTRACTER—For abstracting work in technical library. Must have at least a Bachelor's degree with Chemistry major or equivalent, good reading knowledge of technical French and German, and interest in abstracting and patent searching. Five full and specific details of education, experience, desired salary, availability date, and references. All inquiries will be considered promptly and held in confidence. Mrs. Jeanne R. Manning, Personnel Division, P. O. Box 51, Standard Oil Development Company, Linden, New Jersey.

CHIEF INDUSTRIAL ENGINEER—Responsible to Plant Manager for tooling as well as for methods, standards, processing and estimating. Heavy experience in short-run stainless steel stamping and welding. Proven ability to lead and administer department of 75 people. Act for Plant Manager in his absence. Central Indiana Division of well-known corporation. Address CA-4690, care of "Mechanical Engineering."

DESIGN AND APPLICATION ENGINEER—Regulation and Control Valves. Must have thorough knowledge fluid flow and extensive application experience, possibly in instrument department of large process operation. This is an attractive position with a small manufacturer in Midwest. Salary $8,000 plus bonus. Address CA-4691, care of "Mechanical Engineer4ing."

Growing pulp and paper mill in North Carolina has opening for MECHANICAL ENGINEER to take charge of all plant maintenance. Please include summary of background and experience with reply. Address CA-4667, care of "Mechanical Engineering."

POSITIONS WANTED

MECHANICAL ENGINEER—27 BME (Co-Op) completing 3-year tour with Navy in Research and Development as Project Officer on weapon development. Previous experience 4½ years' diversified experience in steel fabrication and power plant operation. Desire position with opportunities for advancement. Salary open. Write LTJG John J. Lemm, U.S. Naval Underwater Ordnance Station, Newport, R. I.

MECHANICAL ENGINEER—49, married, Scotch-Irish. Experienced in Steam and Power Field. B.S.M.E. (Industrial Engineering) University of Michigan '28. Registered Prof. Engr. States of Ohio, Louisiana, Alabama. Member—ASME—Instr. Soc. of Amer.—Birmingham Engineering Society—Louisiana Engineering Society. Twenty-five years' experience field contact as Sales Engineer. Desires change to Management, Application Engineer, Liaison with Engineering and field men, Purchasing. Available May 1st. Address CA-4654, care of "Mechanical Engineering."

MECHANICAL ENGINEER—B.S., M.S., Registered. 6 years' automotive and aeronautical industry—research and development. 9 years' university-teaching, research, consulting; now associate professor. Available for design or development projects this summer. Location, midwest. Address CA-4660, care of "Mechanical Engineering."

See Advertisements on Preceding Pages

MECHANICAL ENGINEER—BSME, Registered California, Age 33, married. 9 years' diversified experience in design, development, production and sales of farm, automotive and heavy machinery. Past 3 years' as department head. Desire challenging position as works manager or executive engineer. Address CA-4668, care of "Mechanical Engineering."

HEAT EXCHANGE EQUIPMENT DEVELOPMENT—Eleven years' heat transfer research and development experience in petroleum, aircraft, commercial heating, and air conditioning industries. Relocating south, midwest, or southwest. Address CA-4669, care of "Mechanical Engineering."

CRYOGENICS ENGINEER—B.S. in M.E. 33, married, 12 years' experience in all phases of production and handling of liquid oxygen, nitrogen, hydrogen. 7 years' design and development, 2 years' plant engineering, 2½ years' recent line supervision. Executive and sales potential. Desires position with progressive organization. Location immaterial, salary open. Address CA-4679, care of "Mechanical Engineering."

ENGINEER—27, BS in ME, Single, wants development work. 3½ years' design experience in heavy machinery and machine tools, some experience in product design tooling and hydraulics. Prefers midwest or eastern location. Address CA-4687, care of "Mechanical Engineering."

INDUSTRIAL ENGINEER—41, BSME from MIT, broad experience in time and motion study, incentives, job evaluation, complete budgetary control, cost reduction, performance improvement and methods analysis. Address CA-4688, care of "Mechanical Engineering."

HEAT TRANSFER ENGINEER—Outstanding experience of research in heat transfer, refrigeration and heating; holds B.S., M.S. and Ph.D. in Mech. Eng.; seeks responsible position in research or development engineering. Telephone Mitchell 9-4611, Manchester, Conn., or write Box CA-4692, care of "Mechanical Engineering."

RESEARCH ENGINEER—32, B.S.G.E. Registered M.E. 8 years' experience product design, development, research and testing on light to medium heavy equipment. Desires leading position with small progressive plant. Address CA-4683, care of "Mechanical Engineering."

MECHANICAL ENGINEER—14 years' experience in mechanical and electrical fields; close working knowledge machine design, plant layout and construction, tool and process engineering, including executive and administrative duties; degree, license, veteran, married, age 36. Want permanent association with sound midwest firm. Address CA-4681, care of "Mechanical Engineering."

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ENGINEERS AND EXECUTIVES—This confidential service for outstanding men who desire positions paying $5,000 to $40,000 will develop preliminary negotiations with reputable organizations without risk to present position. For complete details, send experience record and expected salary range. Tomsett Associates 337 Frick Bldg., Pittsburgh 19, Pa.

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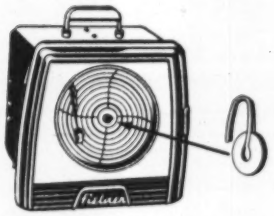
STEAM SPECIALITES—Sales Representatives in contact with industrial plants using steam specialties of quality wanted by Eastern manufacturer. All territories available, except New York and New Jersey. Address CA-4617, care of "Mechanical Engineering."

News About Created-Metals

Thermistors Stabilize Circuit Resistance



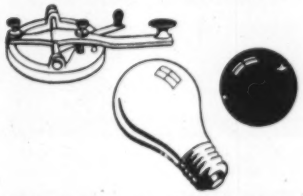
A Carboloy Thermistor improves the accuracy and sensitivity of the Tektolog Electronic Recorder.

Matching the negative temperature coefficient of a Thermistor and a low-resistance manganin shunt to the positive temperature coefficient of the copper coil results in a circuit of constant resistance within ± 5% for ambient temperature from 32° F. to 150° F.

The high degree of compensation is achieved with a relatively low resistance and makes possible accurate recording of voltages as low as 20 millivolts full-scale.

For more information on Thermistors for temperature compensation and detection, warning devices and controls, write: Carboloy Department of General Electric Company, 11133 E. 8 Mile Blvd., Detroit 32, Michigan.

Many Uses Found for Cemented Carbides



The electronics and electrical industries are cutting costs and improving products with wear-resistant cemented carbides.

For example, tough grades of Carboloy cemented carbide are extending the life expectancy of telegraph relay contacts. Carbide-tipped tools are saving time and money in woodworking and cabinetry.

Carbide wire dies for making electric-light filaments and draw dies for making component parts far outlast steel dies. Bearings of chrome carbide are light, strong, nonmagnetic.

Industry is daily finding new uses for cemented carbides. The Carboloy Engineering Appraisal Service will help you put carbides to work in your plant. For more information, write: Carboloy Department of General Electric Company, 11133 E. 8 Mile Blvd., Detroit 32, Michigan.

Give your customer more for his money

SLOW DOWN WEAR

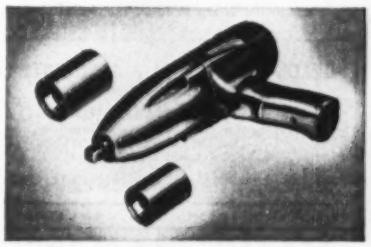
with Carboloy® cemented carbides

Wear is the common denominator of all equipment, reducing life, accuracy and greatly increasing costs.

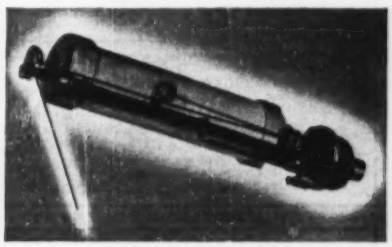
To slow down wear, many product and machine designers are applying Carboloy cemented carbides. In most instances, wherever friction, corrosion, erosion or abrasion are met, Carboloy cemented carbides can increase durability *many times over.*

These three case histories are typical of many more which may suggest important wearproofing possibilities for your own machines and products.

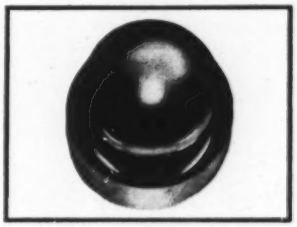
Look over *your* products and call upon the Carboloy Engineering Appraisal Service for expert assistance. We will work with you in selecting and applying the cemented carbide that will best solve *your* wear problem. This service is free. Please write.



Power socket wrenches, equipped with carbide inserts, outlasted ordinary wrenches a minimum of 15 to 20 times; eliminated screw, product damage caused by wrench slippage; sharply cut socket replacement costs and production line downtime.



In textile mills, threads traveling at high speeds quickly cut through steel or porcelain guides. Carbide guide ring inserts, used to resist such wear, lasted 50 to 100 times longer. They also greatly reduced thread snagging and snapping, spoilage and downtime.



Subsurface pumps in oil wells use balls and seats of Carboloy cemented carbide to resist acids and abrasive sands found in crude oil. Carboloy balls and seats outlast steel 20 times; maintain sphericity under severest conditions of impact and pressures.

Put These Outstanding Characteristics To Work In *Your* Plant:

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- High heat resistance
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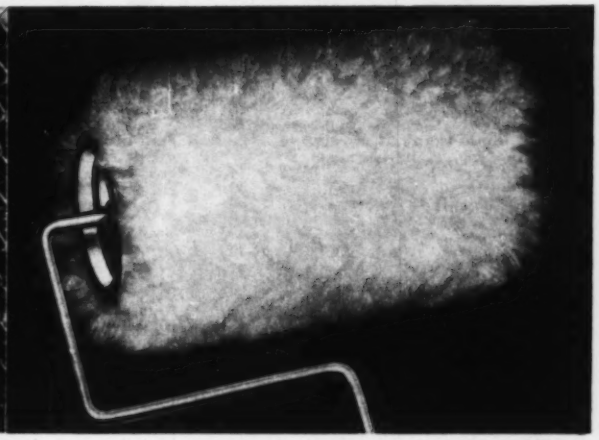
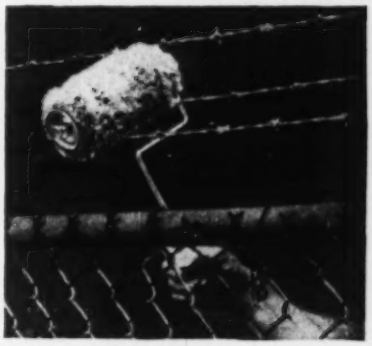
Special roller glides easily over wire sections. (Rusted sections have already been primed with Rust-Oleum 769 Damp-Proof Red Primer to Stop Rust.) Finish coat is Rust-Oleum 470 R.M. Aluminum.



A *new, exclusive, different-type* roller! Greater diameter, specially selected skins, extra-long Lamb's Wool – all combine to give you more coverage faster and easier in the new Rust-Oleum Roller-Coating System.

Close-up shows how Extra-Long Nap Wool reaches around to coat approximately 70% of other side of fence at same time. Rust-Oleum's *exclusive* penetrating qualities saturate cross wire sections for desired mil thickness.

Man follows with "dry" roller on opposite side of fence to catch and use surplus "tears" and quickly coat remaining 30% of wire sections.



Even barbed wire sections can be roller-coated in one easy pass. 99% of the material is used on the fence – *not* on the workers, *not* on the ground.

On long distances of fencing, a 5 man production "team" can achieve even greater savings. The first man wirebrushes the surface to remove dirt, dust, rust scale, etc. The second man applies Rust-Oleum liberally by roller, coating the wire sections and barbed wire. The third man follows on the opposite side of the fence with a "dry" roller to catch and use the surplus. The fourth and fifth men work on opposite sides of the fence, brushing the pipe framework and the barbed wire arms. See how this new Rust-Oleum system can save you money. Attach coupon to your letterhead, mail *today*.

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ATTACH TO YOUR LETTERHEAD - MAIL TODAY!

RUST-OLEUM CORPORATION
2902 Oakton Street, Evanston, Illinois

Please show us how your new Extra-Long Nap Lamb's Wool Roller will cut our wire fence re-coating costs. Include prices, complete literature about Rust-Oleum and nearest source of supply. We have approximately_____ yards of wire fencing.

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Sirrine, J. E., Co.
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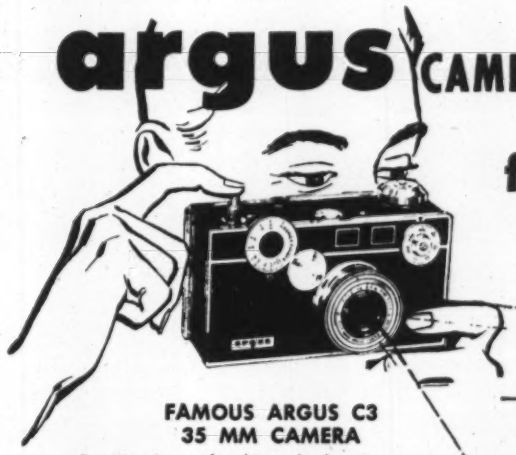
argus CAMERAS, INC., ANN ARBOR, MICH.

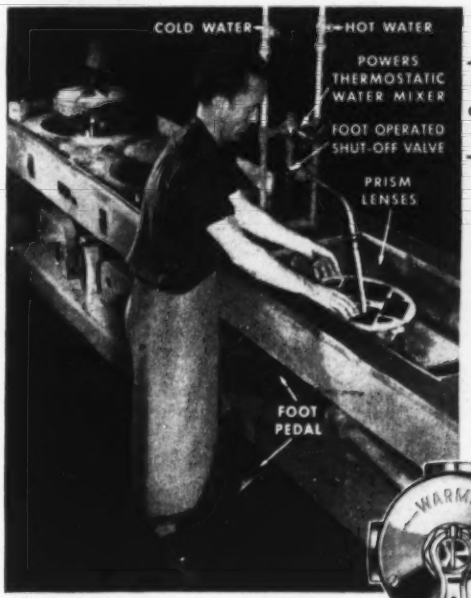
focused on POWERS Temperature Control



FAMOUS ARGUS C3 35 MM CAMERA

Precision Lenses for this and other Argus cameras, and projectors and optical components for complex optical instruments used in our nation's defense — are produced in Argus' modern optical plant.

—for better regulation of washing polished lens blocks



Worth an extra pair of hands

HERE ARE THE RESULTS

Combination of a POWERS Type H Thermostatic Water Mixer and a Bradley foot operated shut-off valve release both of worker's hands for lens washing. Instant shut off prevents waste of water. Accurate control of water temperature prevents damage to lens.

75 Powers Thermostatic Water Mixers are used in Argus' large completely modern optical plant. Row upon row of machines like those shown here polish lenses and prisms to a high degree of accuracy.

POWERS Control Saves Labor and Hot Water . . . *Also Helps Prevent Damage to Lenses*

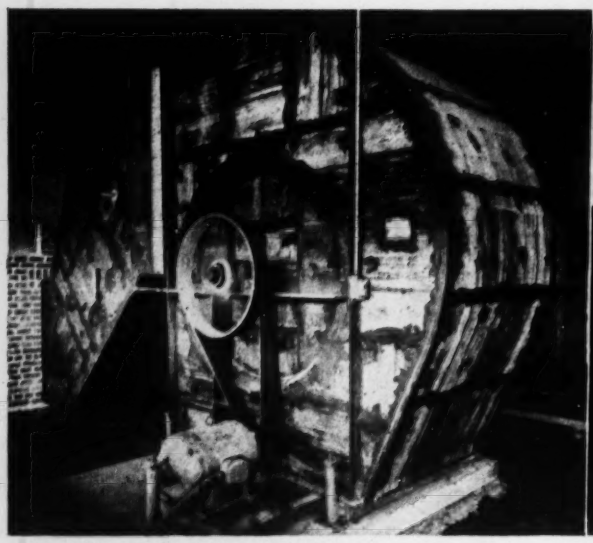
Accurate temperature control of water used in washing lens blocks is very important. The double safety of a Powers thermostatic water mixer shown at left insures the most accurate control obtainable.

It automatically mixes hot and cold water and delivers a mixture at any temperature desired regardless of **pressure** or **temperature** changes in water supply lines. Failure of cold water instantly shuts off the delivery. Users often report accuracy of ± ½° F. Capacity 2 to 10 gpm @ 45 psi. Write for Bulletin 365. Larger Capacity Water Mixers available up to 1200 gpm @ 45 psi. Write for Catalog WC.

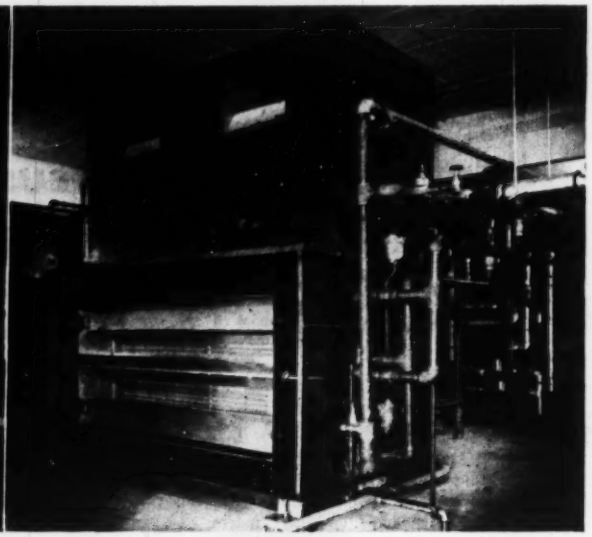
Check Your Control Problem with an Experienced POWERS Engineer. He will help you select the proper type of control for your requirements. Contact our nearest office or write us direct.

(b68)

Established in 1891 • **THE POWERS REGULATOR COMPANY** • SKOKIE, ILL. • Offices in Over 50 Cities



In its "work clothes" — completely insulated — one of the Clarage Type NH ventilating fans.



One of the Clarage Multitherm air conditioning units on the job — vertical type shown.

Typically Texas

Harris County boasts 2 new Court Houses at Houston. Clarage equipment installed in both!

Not one, but TWO . . . that's the number of Court Houses serving booming Harris County.

Likewise impressive is the amount of Clarage equipment selected for these two installations. In the **new** Harris County Court House: 49 Multitherm Units, 2 Unicoil Units, 22 fans. In the **remodeled** Harris County Court House: 37 Multitherm Units, 20 fans.

You, too, will find it makes sense to choose dependable Clarage equipment. Your inquiry is invited. **CLARAGE FAN COMPANY, Kalamazoo, Michigan.**

The new Harris County Court House at Houston, Texas. ARCHITECT: Finger and Rustay. ENGINEER: I. A. Naman. CONTRACTOR: Charles G. Heyne & Company.

YOURS FOR THE ASKING

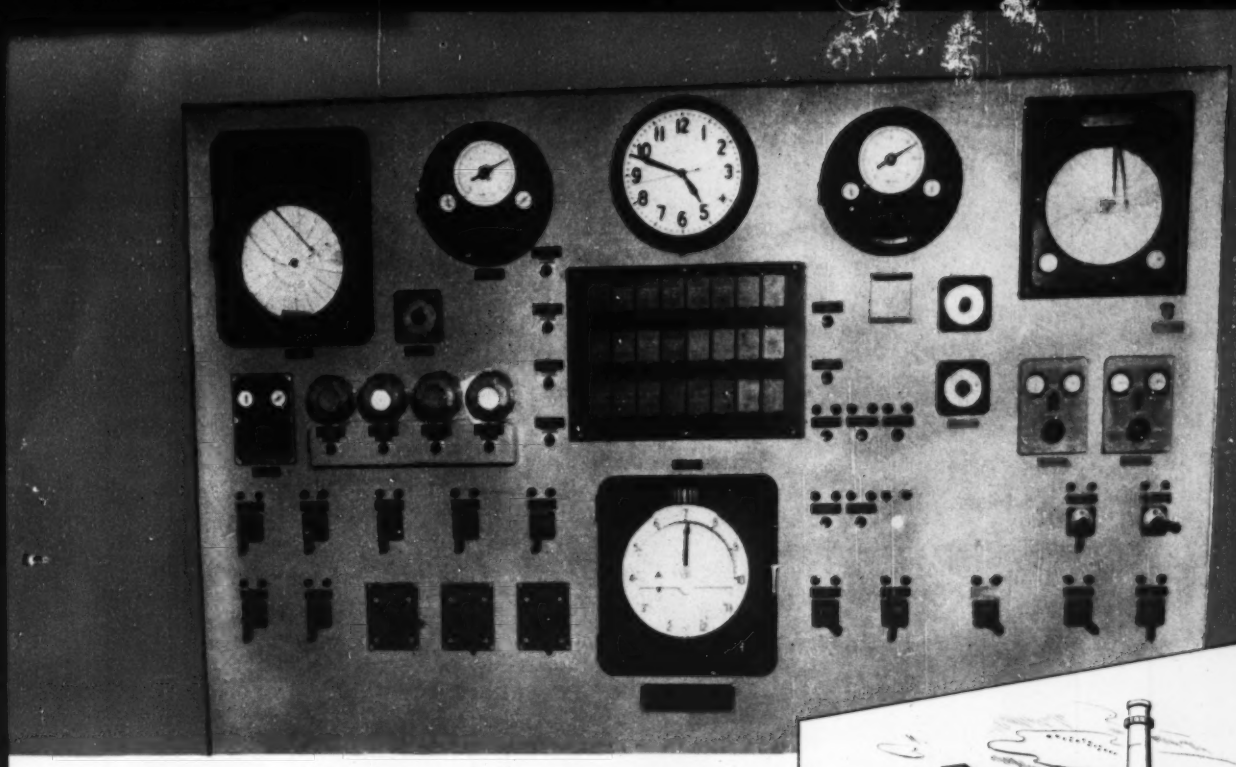
This 68-page illustrated Service Manual provides valuable information adaptable to virtually any air handling job. Send for your free copy today.

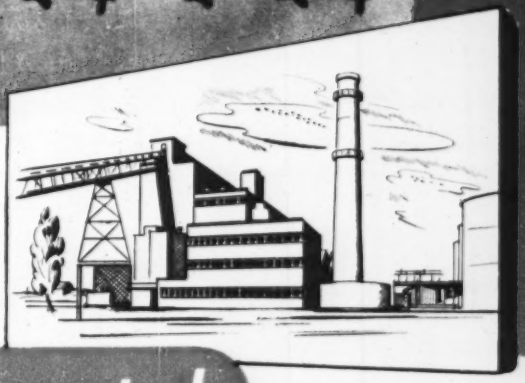
You can Rely on...

CLARAGE

Headquarters for Air Handling and Conditioning Equipment

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans Ltd., 4225 R[illegible] St., Montreal





Atlantic City Electric Company selects PERMUTIT WATER CONDITIONING with centralized, automatic control

Greenwich Station. Normal steam capacity: 460,000 lb per hr. Engineered and constructed by Burns and Roe, Inc., New York City.

To FILL *changing* demand for 100% makeup with highest purity feedwater requires the best of equipment and a degree of efficiency obtainable only with modern automatic control.

At the Greenwich Station, instrumentation — centralized in Permutit cubicles — provides this control. The water-treatment plant supplies makeup that meets requirements for two 650 psig boilers operating under *wide ranges* in load . . . for steam output and turbo-generator exhaust must also fill the changing process-steam needs of a very large, nearby chemical plant.

TREATMENT METHODS SPECIFIED

Consulting engineers investigated several plans to determine the most efficient and economical means of making Delaware River water satisfactory for two 230,000 lb per hr boilers. Final decision was to treat the water with *Permutit equipment:* coagulation, silica reduction, filtration, hydrogen-sodium-zeolite softening, degasification . . . with provision for demineralization if required.

REQUIREMENTS FOR COMPLETE CONTROL

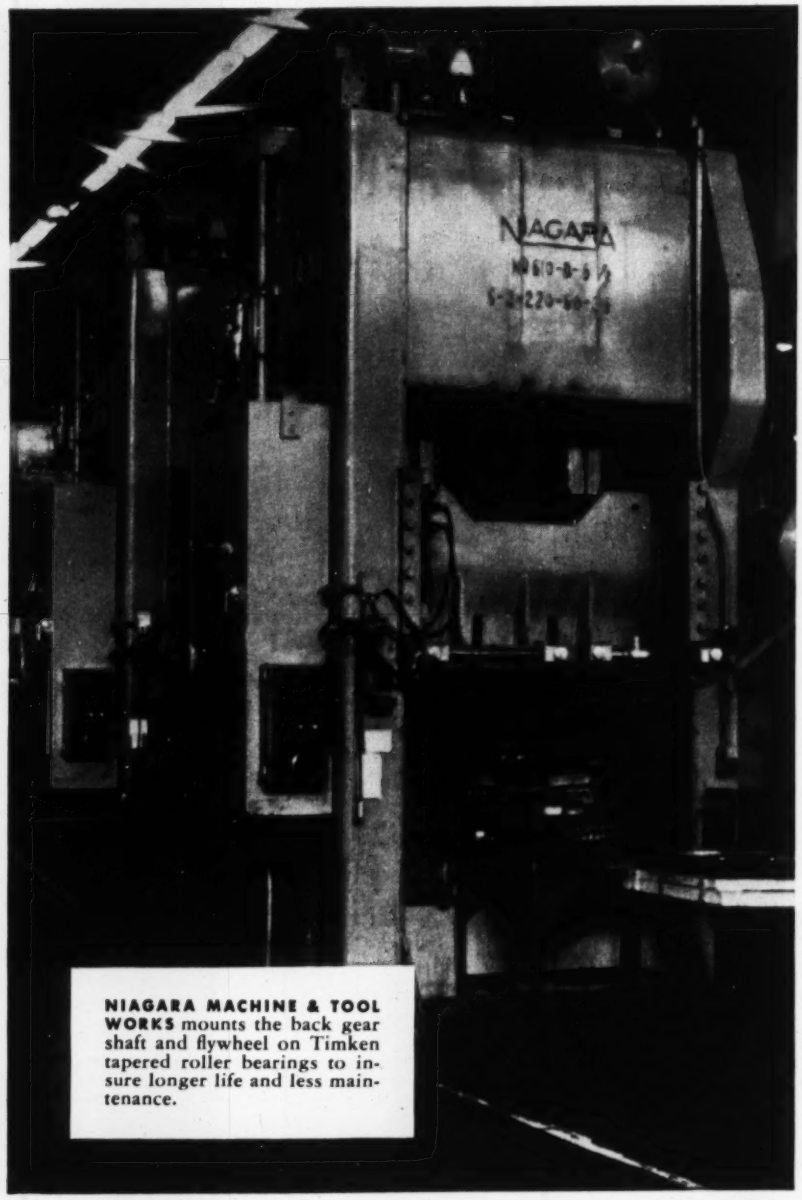
Mounted on the Permutit central control board are flow controllers and loss of head gauges for each filter; flow recorders, level indicators, alarms, timing devices, etc. A pH indicator assures proper blending of the sodium and hydrogen-zeolite softened waters. After setting flow rates, timing elements, etc., this entire Permutit water-treatment system operates *automatically!*

Find out how Permutit can solve your water problems. Write to THE PERMUTIT COMPANY, Dept. ME-5, 330 West 42nd Street, New York 36, N. Y. or Permutit Company of Canada, Ltd., 6975 Jeanné Mance Street, Montreal.

PERMUTIT®

ION EXCHANGE AND WATER CONDITIONING HEADQUARTERS FOR OVER 40 YEARS

How TIMKEN® bearings cut maintenance on auto body stamping presses



NIAGARA MACHINE & TOOL WORKS mounts the back gear shaft and flywheel on Timken tapered roller bearings to insure longer life and less maintenance.

MAINTENANCE and downtime are low in the stamping department of one large automotive manufacturer. One reason: 30 new-design Niagara double crank presses have the back gear shaft and flywheel on Timken® tapered roller bearings.

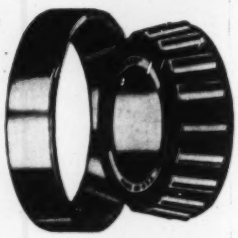
Every time the press stamps a part, the bearings on the back gear shaft take the heavy shock load. Timken bearings take these loads with ease because rollers and races are case-hardened. This gives them a hard, wear-resistant surface over a tough, shock-resistant core. Full line contact between rollers and races of Timken bearings gives them extra load carrying capacity to hold shafts in line. There's minimum maintenance, less downtime.

Timken bearings help gears last longer, too. They insure accurate gear mesh because Timken bearings' tapered construction lets them take both radial and thrust loads in any combination. The taper prevents lateral movement of the shaft. Flywheels do not become worn or loose, crankshaft wear is prevented.

Be sure to specify Timken bearings for all the machinery you build or buy. They give longer life with less friction. Look for the trade-mark "Timken" on every bearing. The Timken Roller Bearing Company, Canton 6, O. Canadian plant: St. Thomas, Ont. Cable address: "TIMROSCO".

TIMKEN BEARING EQUIPPED

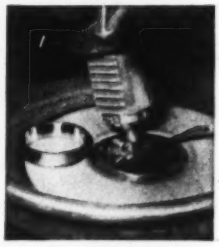
This symbol on a product means its bearings are the best.



TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS



FINISHED TO CLOSER TOLERANCES

Finishing to incredible smoothness accounts for much of the precise, smooth rolling performance of Timken bearings. This honing operation is typical of the amazingly accurate manufacturing methods at the Timken Company.

The Timken Company is the acknowledged leader in: 1. advanced design; 2. precision manufacturing; 3. rigid quality control; 4. special analysis steels.

NOT JUST A BALL ◯ NOT JUST A ROLLER ⬭ THE TIMKEN TAPERED ROLLER ⬭ BEARING TAKES RADIAL ◎ AND THRUST →◎← LOADS OR ANY COMBINATION →✳←